Engineering News

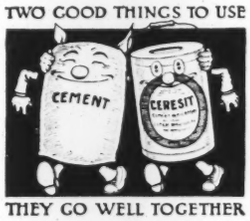
Issued Every Thursday
Hill Publishing Company

NEW YORK, APRIL 30, 1914

Price, 15 Cents. $5 Yearly
To Canada, $7. Foreign, $9

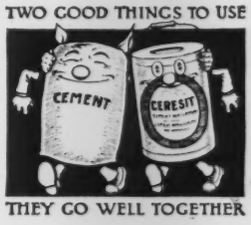
C E R E S I T

A Dependable Waterproofer for Cement



Ceresit is a reliable waterproofer for all kinds of cement construction, under any condition of dampness or water pressure.

Ceresit is a paste. It is mixed with the water used for tempering cement mortar or concrete. The water, being the carrying agent, insures a perfect and uniform distribution of Ceresit throughout the mass. The method of use is simple, and the results absolute and permanent.



Engineers and Contractors

Get the facts. Let us give you the results of tests by authorities. Let us show you hundreds of instances where Ceresit has been used. Let us prove to you that Ceresit is a cement waterproofer that any Engineer can specify with confidence and that any Contractor can use successfully.

Write for the "Book of Evidence."

Ceresit Waterproofing Company
931 Westminster Building, Chicago
FACTORIES—Chicago; Unna, Germany; London; Paris; Vienna; Warsaw.

C E R E S I T

640 Tons of Lackawanna Steel Sheet Piling Used in the Manhattan Approach to the Harlem River Tubes, New York City

The photograph, taken at the river end of the cofferdam, shows preliminary excavation to a depth of about 15 feet. It was first attempted to drive the Lackawanna Steel Sheet Piling to this depth, excavate, then drive the piling farther, excavate again, and so on until bed rock was reached, but, the outside pressure was so great that water and sand were forced around under the piling. To overcome this trouble the piling was thereafter driven all the way to bed rock before excavation was started. The depth to bedrock at the place shown above is 58 feet.

Lackawanna Steel Sheet Piling is daily demonstrating its superiority for simplifying construction work that would otherwise be difficult. It is the strongest longitudinally and transversely, is flexible in the joint, is watertight and is easy to drive and pull.

Our engineers have figured on an immense number of steel sheet piling problems covering every imaginable condition. You can therefore be sure that their advice on any piling job is worth while. This advice is yours for the asking. Write today and at the same time ask us to send our new bulletin, No. 106, "Lackawanna Steel Sheet Piling."

LACKAWANNA STEEL COMPANY

General Sales Office and Works: Lackawanna, N. Y.

NEW YORK BOSTON BUFFALO PHILADELPHIA CLEVELAND CINCINNATI CHICAGO DETROIT ST. LOUIS ATLANTA SAN FRANCISCO MONTREAL

Licensees for the manufacture of Lackawanna Steel Sheet Piling:

For Great Britain and British Colonies in the Eastern Hemisphere, Cargo-Fleet-Iron Co., Ltd., Middlesborough, England. For France, Italy, Spain, French Colonies and Protectorates, Italian Colonies and Spanish Colonies in the Eastern Hemisphere: Cie Des Forges & Aciéries de la Marine et d'Homécourt, Paris, France.

Engineering News

CHARLES WHITING BAKER, *Editor*

Subscriptions payable in advance, $5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $7.00 in Canada.

Published Weekly By HILL PUBLISHING COMPANY
505 Pearl Street, New York, N. Y.

JOHN A. HILL, Pres. ROB'T MCKEAN, Sec'y.

Cable Address: "ENGNEWS"

To foreign countries, including postage, $9.00 or its equivalen 38 shillings: 38 marks: or 47 francs. Subscriptions for Great Britain, Europe or British Colonies may be sent to London Office, 6 Bouverie St., London, E. C., England. Notice to change address should be written to the New York Office in every instance. Advertising copy should reach New York Office two weeks before date of issue. Entered at New York Postoffice as mail matter of the second class.

VOLUME 71 APRIL 30, 1914 NUMBER 18

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

*Illustrated Article

*INSTALLATION OF SIX HIGH-TENSION CABLES IN THE OHIO RIVER AT PITTSBURGH: *Page* 939

Various steps pictured in laying a submarine transmission system. 800 w. 5 ill. W. A. Keating. ENGINEERING NEWS, Apr. 30, 1914.

ILLUMINATION OF RAILWAY SIGNALS: *Page* 941

Development of present practice. 1200 w. Thos. S. Stevens. ENGINEERING NEWS, Apr. 30, 1914.

*DESIGN OF THE SUPERSTRUCTURE OF THE NEW QUEBEC BRIDGE: *Page* 942

Foundations of new 1800-ft. cantilever bridge completed and shopwork on superstructure in progress, floor-system already completed nickel-steel in main trusses; K-truss system; members made in two or four erection pieces to bring weights down to 100 tons; compression-chord sections; top-chord eye-bars trussed. 3000 w. 2 ill. and insert sheet. H. P. Borden. ENGINEERING NEWS, Apr. 30, 1914.

AN EARLY EXPERIMENTAL PAVEMENT—AN INTERESTING BIT OF PAVEMENT HISTORY: *Page* 945

Account of an experimental pavement in Oxford St., London, England, in 1840; early history of asphalt pavement. 600 w. ENGINEERING NEWS, Apr. 30 ,1914.

*THE NARROWS SIPHON OF THE CATSKILL AQUEDUCT: *Page* 946

About 9600 ft. of 36-in. cast-iron pipe, with a special design of flexible joints, is to be laid beneath the Narrows, between Brooklyn and Richmond Boroughs; a general description is followed by extracts from the specifications. 2100 w. 4 ill. ENGINERING NEWS, Apr. 30, 1914.

SUPERVISING THE EXECUTION OF LARGE PERCENTAGE CONTRACTS TO PROTECT THE CLIENTS' INTERESTS: *Page* 948

Describes the duties of a supervising engineer on percentage contracts. 1500 w. G. G. Ommanney. ENGINEERING NEWS, Apr. 30, 1914.

*RANGOON RIVER TRAINING WALL, RANGOON, BURMAH: *Page* 950

A stone wall over two miles long founded in water up 50 ft. depth on brush mattresses; one of the world's largest river protection schemes; cost, $5,000,000. 2400 w. 9 ill. ENGINEERING NEWS, Apr. 30, 1914.

*NEW SPECIFICATIONS FOR CONCRETE PAVEMENTS, N. Y. STATE HIGHWAYS COMMISSION: *Page* 954

Gives new specifications designed to give more permanent pavement than old. 1200 w. 1 ill. ENGINEERING NEWS, Apr. 30, 1914.

PROTECTION OF NEW PAVEMENTS AGAINST DESTRUCTION BY TRENCHING, MACON, GA.: *Page* 955

Reprint of city regulations governing the opening up of paved streets. 400 w. ENGINEERING NEWS, Apr. 30, 1914.

*ANCHOR-BOLT TENSION; SIX DIFFERENT RESULTS FROM SIX BOOKS: *Page* 956

Six books give six formulas showing for a particular chimney 25,000 to 57,000 lb. tension per bolt; discussion by Editor explains the physical conditions of the problem and develops formulas for certain conditions. 3500 w. 1 ill. R. Fleming. ENGINERING NEWS, Apr. 30, 1914.

*KANSAS CITY SPECIFICATIONS FOR SEWER PIPE, AND EXPERIENCE IN TESTING SEWER PIPE: *Page* 959

Testing percolation under internal water pressure is used in preference to crushing test; percentages of rejection during a year, per day and for cement pipe. 2200 w. 1 ill. Elwood S. Wallace. ENGINEERING NEWS, Apr. 30, 1914.

PROMOTION EXAMINATION FROM JUNIOR ENGINEER TO DESIGNER WITH THE PUBLIC SERVICE COMMISSION, FIRST DISTRICT, NEW YORK: *Page* 961

900 w. ENGINEERING NEWS, Apr. 30, 1914.

*LOST RIVER MULTIPLE-ARCH CURVED DAM: *Page* 962

A diversion dam to unwater lands recently flooded by a no-outlet lake; earth embankments held by reinforced concrete retaining walls flank a multiple-arch concrete overflow dam, of horseshoe plan, which with a low dam between the toes of the horseshoe inclosed a stilling pool having a reinforced-concrete bottom, floored with plank. 4000 w. 9 ill. W. W. Patch. ENGINEERING NEWS, Apr. 30, 1914.

*CANTILEVER CANOPIES FOR PLATFORM SHELTERS ON THE CHICAGO ELEVATED RAILWAYS: *Page* 968

Brief description of. 600 w. 3 ill. ENGINEERING NEWS, Apr. 30, 1914.

FERTILIZING VALUE OF SEWAGE AND SEWAGE SLUDGE: *Page* 969

Abstract of a review of this subject by H. W. Clark, Chemist to the Massachusetts State Board of Health. 700 w. ENGINERING NEWS, Apr. 30, 1914.

GRAND JURY PRESENTMENT ON CONTRACT WORK IN NEW YORK: *Page* 970

600 w. ENGINEERING NEWS, Apr. 30, 1914.

*MUNICIPAL REFUSE SORTING AND UTILIZATION PLANT AT PITTSBURGH, PENN.: *Page* 980

Various grades of paper and other salable wastes are sorted out from a picking felt; the tailings go to a destructor furnace, the heat from which supplies electricity for plant purposes and a surplus which will ultimately be sold. 1000 w. 4 ill. Sterling H. Bunnell. ENGINEERING NEWS, Apr. 30, 1914.

THE NEW ENGLAND WATER-WORKS ASSOCIATION'S STANDARD SPECIFICATIONS FOR WATER-WORKS POST HYDRANTS: *Page* 984

ENGINEERING NEWS, Apr. 30, 1914.

MUNICIPAL PORT IMPROVEMENT P-
VILLE, FLA.:
Outlines a $1,500,000
project. 1000 w.

NATION-

Biographical S...
NEWS, Apr. 30, 1914.

EDITORIALS: *Page* 971

LETTERS: *Page* 974

ENGINEERING NEWS OF THE WEEK: *Page* 997

PERSONALS: *Page* 975

ENGINEERING SOCIETIES: *Page* 996

CONSTRUCTION NEWS: *Page* 255

CONTRACTS TO BE LET: *Page* 43

WANT ADVERTISEMENTS: *Page* 50

ADVERTISING INDEX: *Page* 96

NUMBER OF COPIES PRINTED THIS ISSUE 22,200

None sent free regularly, no returns from news companies, no back numbers.

What The Buyer Needs To Know

Number Seventy

¶ Don't fool yourself into believing that the way of yesterday is the way of today in doing things in the engineering and contracting field. ¶ Something new is discovered every day. ¶ Don't fool yourself into believing that the manufacturers of engineering equipment are sleeping. ¶ They are on tip-toes every day in the week and every week of the year, bringing out better machinery. ¶ Don't fool yourself into believing that ads of today are mere names and addresses and blatant assertions of superiority. ¶ They are true stories of the progress being made in equipment and supplies in your field—they are your best opportunity to keep abreast of a fast moving times.

¶ *Read the Ads!*

MAY -1 1914

Engineering News

VOLUME 71 APRIL 30, 1914 NUMBER 18

Installation of Six High-Tension Cables in the Ohio River at Pittsburgh

By W. A. Keating*

Cables—The submarine cables described in this article are part of the three-phase 11,000-volt transmission system of the Duquesne Light Co., of Pittsburgh. They carry the current generated at the Brunots Island Plant, to the north shore of the Ohio River. This island is about three miles below Pittsburgh and measures approximately one-half mile in width, and a mile and one-half in length. The cables are made up of three No. 0000 B. & S.-gage conductors insulated with $^{21}/_{64}$ in. of 30% para rubber, plus a tape; there is also a jute filler, a tape over core; No. 4 B.w.g. galvanized-steel armor wires and a saturated jute serving over all. The cables weigh approximately 20 lb. per ft. and were reeled in 920-ft. lengths, each length representing a complete line from shore to shore. The total weight of the six cables on reels was 54 tons.

Preliminary Work—Previous to the arrival of the cable on the scene of the work, a trench, 10 ft. across the bottom, 20 ft. across the top and 4 ft. in depth, was dredged in the bed of the river between the two terminal points. Experiments made some months before showed that there was no rock in the river bed and consequently blasting was unnecessary. These experiments consisted of driving rods into the earth at the bottom of the river. A river dredge (dipper type) was used for digging the ditch.

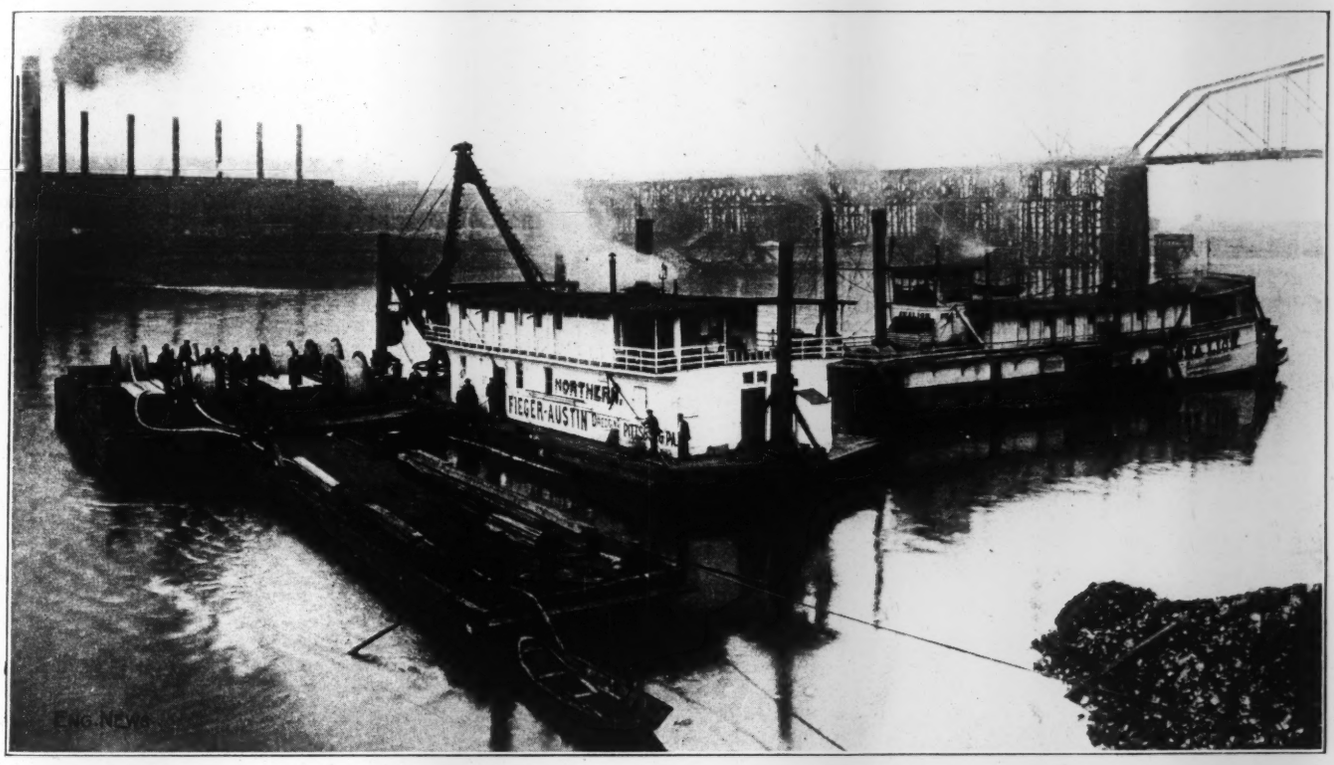


Fig. 1. Laying High-Tension Cables under the Ohio River at Pittsburgh

(River equipment for hauling cables into mainland conduits; reels on mud scows, dredge anchored downstream with vertical spuds, pusher steamboat as precaution against swift current. A 3-in. oil-pipe line lifted over end of flat.)

Laying—Upon the arrival of the cable at Pittsburgh, it was unloaded from cars at the wharf, rolled to the waters edge and loaded upon mud scows and towed to the scene of laying. The six ends were then pulled into the manhole on the north shore, by means of a rope threaded through one duct into the manhole and back to the boat through another duct.

In order to prevent a sharp bend where the cables leave the duct, a concrete saddle, curved to support the cables, was built into the bank.

In landing the ends of the cables it was necessary to raise a pipe line, draw the cables under it and lower it again into place. This line, three inches in diameter, carries oil from Coraopolis to the North Side at a pressure of 800 lb. During the time it was raised, the pres-

*Engineer, Distribution Department, Duquesne Light Co., Pittsburgh, Penn.

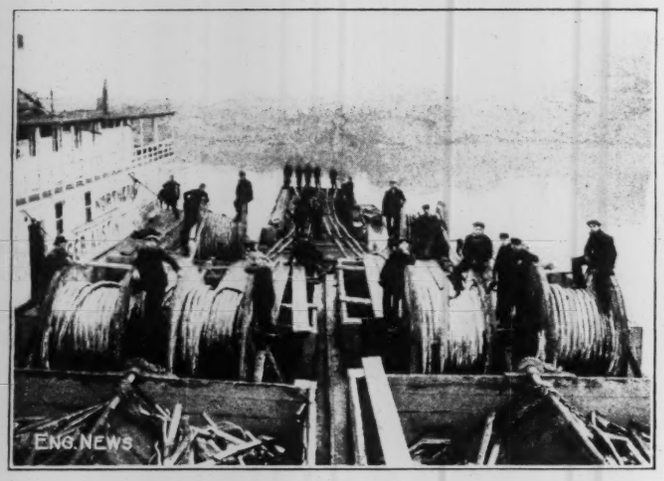


FIG. 2. REELS ON SCOWS AND CABLE ON FLAT
(Rollers under cables on flat to reduce friction in paying out.)

sure was shut off. The line, however, was full of oil and to break it meant danger of fire from the oil becoming ignited from the fires under the boilers on the steamboat. It was not damaged, however, in handling and was replaced in its former position. After the ends were made fast in the manhole, the boats moved out into the river and the cable was paid out over the stern of a flat on which the cables were trained, after leaving the mud scows. As the boats moved out, the cables were pulled forward on the flat by the capstan on the forward deck of the steamer so as to relieve the strain on them and to allow them to lie on the bottom as much as possible, and without becoming crossed.

FIG. 3. CABLES LEAVING SCOWS AFTER REMOVING FLAT

Upon reaching the island shore, the flat was taken away from the rear of the scows, the cables on it being dropped overboard, as it was allowed to float downstream. The empty flat was then put back into its original position, floating over the cables, and the balance of the cable on the reels, unreeled back upon it. This put the cables in position for paying out over the bow of the flat, which was slowly pushed to the island shore. The ends were easily dragged up on the bank and drawn through an opening in the concrete dike, into a manhole in which they connected to cables from the station.

A submarine diver was commissioned to examine the installation and determine the condition of cables. He found the cables in the trench, except in midriver, where the undertow from a steamer wheel had carried them downstream. A line was fastened to them, and the diver

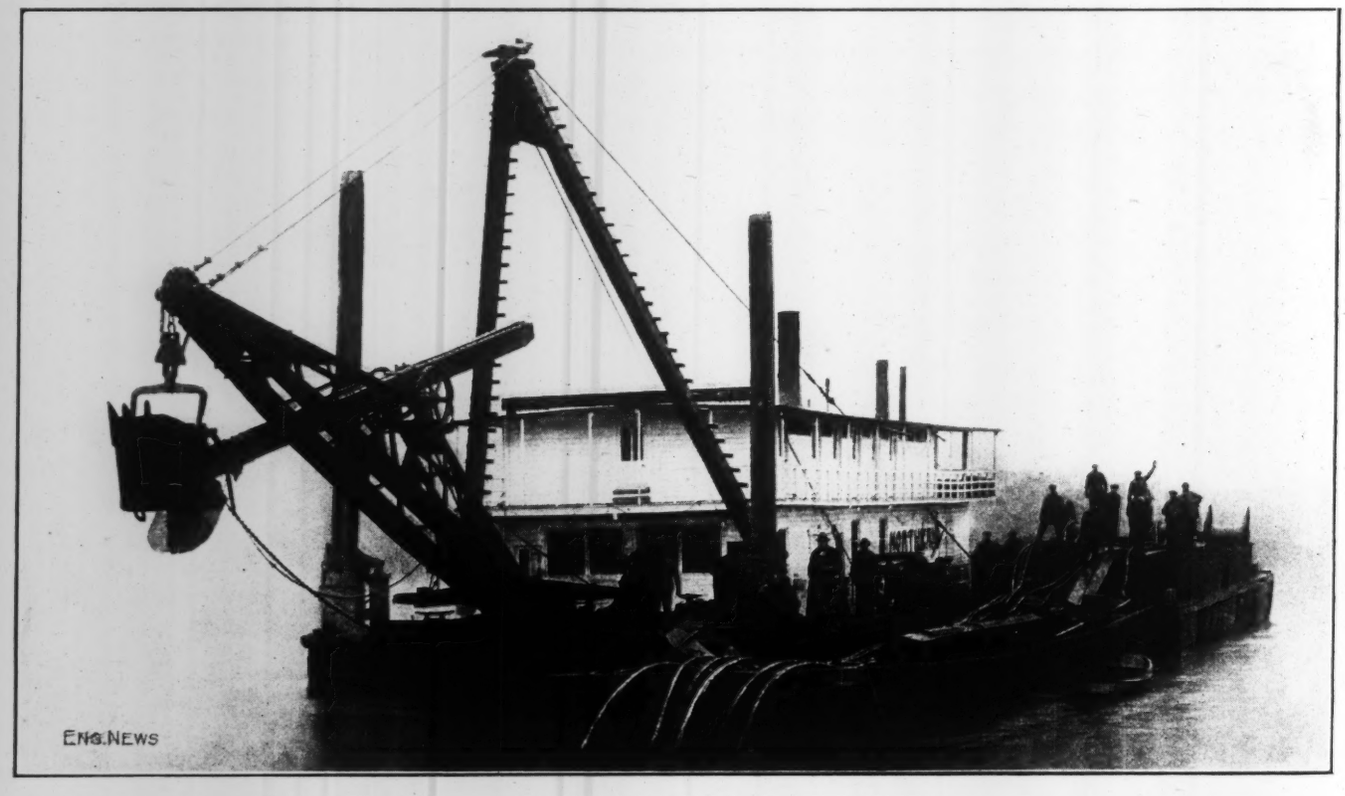


FIG. 4. CABLE APPROACHING ISLAND SHORE
(Showing flat and scow, with cable paying out over bow of flat instead of stern. As the boats were pushed forward, cable was paid out. After 60 ft. advance, the scow was empty and was removed. The flat was then pushed toward shore until about 40-ft. lengths of cables was left. The ends were then easily taken up on shore and drawn into the manhole back of the dike.)

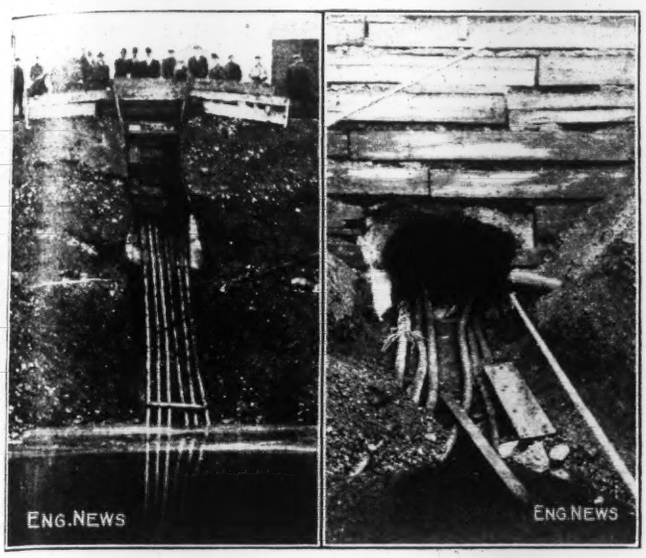


FIG. 5. LANDING PLACES ON ALLEGHENY (LEFT) AND ISLAND (RIGHT) SHORES

by signaling from the bottom of the river directed their replacement.

The cables were tested out successfully at 22,000 volts, and two of them put into service. The trench was allowed to fill from the wash of the current. The installation required, in all, 20 days of 10 hours each to complete.

Illumination of Railway Signals*

BY THOMAS S. STEVENS†

The development of signal illumination has been along three definite lines: (1) kerosene lamps; (2) electric lamps; (3) acetylene lamps.

The first oil lamps and burners were crude affairs, and there were no ideas as to their requirements. At first little was known about the proper ventilation of the lamps, the different currents of air which might affect the flame, the proper vents to provide for the escape of the products of combustion or the effects of improper ventilation on the deterioration of the metal by rust. After a great deal of experimenting, a method called a balanced draught was developed which solved the problem by providing for sufficient air to enter the lamp along a proper path so that combustion is provided for by a current of air which is partially warmed before coming in contact with the flame. At the same time proper paths have been provided for the exhausted air to escape without the possibility of sudden gusts of wind causing interior disturbances which might extinguish the flame. The result of all this has been that a steady flame, free from smoke, is provided and the condition of the air inside the lamp is such that no moisture is precipitated under any weather conditions and consequently no rusting effects exist.

At first burners requiring attention every day were used. These, except for provisions for protecting the flame, were very similar to those used for domestic illumination and no particular development has been made.

When more perfect combustion became possible a smaller burner was thought of, far more economical in every way, called the "long time" burner. This burner, with a slightly larger oil cup, would successfully illuminate a signal for seven days if it were not for the difficulty experienced in keeping the top of the wick free from the crust which forms through lack of heat to consume the impurities in the oil. In order to take care of this condition, lamps are given attention twice weekly and even then are far more economical than the one-day burner on account of the decreased consumption of oil and labor. At first reflectors were used because it was feared that sufficient light would not be afforded, but investigations proved that the effective illumination of a lens is accomplished by a bright light on its center line and at the proper focal distance. It was found that as the effect of the reflector was to diffuse the light all over the lens, very little if any increased illumination was produced. The same fact explains why a one-day burner of far higher candle-power than the long-time burner, when tested by itself, gives so little added illumination when projected through a lens. Even with attention twice a week, the burners would clog sometimes unless very high-grade oils were used, and eventually the flame was increased slightly to increase the heat and the burners became very satisfactory for moderate grades of oil. Recently a tinsmith developed an inexpensive attachment for this burner which, by providing a small buffer for the retention of heat, supplements the natural combustion of the burner and so permits the use of a lower grade of oil developed from an asphalt base. Tests are under way and there is reason to expect success.

The construction of a wick for such a burner was a problem in itself. The flow of oil is so slow due to the small consumption that, particularly with oils from an asphalt base, there was considerable filtration which eventually clogged most of the original designs. One ingenious lampman issued a dry vine stem with very good results, but the ultimate design was a piece of felt doubled over and sewn together with a small thread run through its center.

Naturally the long-time burner with its small flame is more liable to extinguishment by shocks and so it has not been used extensively for train markers or engine classification lamps in which some of the lenses are too large for proper illumination by a small flame. Added to this is the fact that labor for the care of these lamps costs nothing extra, and as the big saving is made on this account there has been no incentive to develop a long-time burner.

Wherever practicable electric lights have been introduced. As in the case of the oil lamp, at first far more illumination was provided than was needed owing to the lack of knowledge of the properties of lenses. One of the first plants to be so equipped was in Topeka, where 16-cp. lamps were used in high signals and 8-cp. in dwarfs. No one stopped to make a comparison with the oil lamps which had been in use and which provided only a little over 1 cp. A reduction was soon made to 4-cp., then to 2. Now many small all-electric plants are lighted with 1-cp. lamps which can be readily seen for a distance of two miles. Again, the principle of a small bright light in the center of a perfect lens at the proper focal distance is the cause. At the larger plants power is taken, of course, from dynamos direct or from some local supply, but on the smaller plants it is taken from storage batteries charged by gasoline-engine driven units. The energy consumption of the 1-cp. lamps is so small that a very small battery will provide power and light for a fair-sized plant for two or three days.

Recently extensive installations of alternating-current electric signals have been made with, of course, the lamps lighted electrically. Because it seemed more economical, the lamps are burned all day because only 2-cp. lamps are used and the cost of the energy consumed is less than that of any control circuit which could be designed. There has been developed a relay for control of such functions based on the expansion and contraction of metal rods under the effect of light, but these have only been applied to channel buoys where considerable power is used and I do not know of the development of a relay small enough for use on signal circuits. It is probable that the cost would be too great even if it were developed.

Recently a Swedish firm has introduced an acetylene lamp which has received more or less attention. Acetylene gas for illumination of signals had been used before, but this firm developed a very ingenious valve to produce a flashing light which they claim renders signals more distinctive.

Lenses have been brought to such a perfection today that it has been found practicable properly to illuminate signals so that the different colors can be readily distinguished in daylight at 2000 ft. Of course, this is only possible where electric light can be used, but it provides a very cheap and efficient way to signal electric roads where plenty of power is available at a cheap rate. All the complicated mechanisms necessary for the mechanical operation of signal arms are eliminated and replaced by simple electrical circuits which are far more efficient and economical to maintain. In the majority of cases two 10-cp. lamps are used behind an 8-in. lens. It would appear that the problem with this type of signaling is to provide a light signal sufficiently visible in bright sunlight not too prominent at night.

The subject of the illumination of signals is intimately connected with the development of lenses. Were it not for this, neither the long-time burner nor the low-power electric lamp could have been used.

*From a paper presented at a meeting of the Chicago Section of the Illuminating Engineering Society, April 10, 1914.

†Atchison, Topeka & Santa Fé Ry., Topeka, Kan.

Design of the Superstructure of the New Quebec Bridge

[With Insert Sheet Showing Design]

By H. P. Borden*

Work on the reconstruction of the new Quebec Bridge over the St. Lawrence River is making very satisfactory progress. The work in connection with the substructure has extended over the past four years, and was finally completed during the past season with the exception of finishing the bridge seats and other minor details.

While the masonry included in this contract, amounting to some 106,000 cu.yd., probably constitutes a record for four piers, yet the only problems of any serious nature were those encountered in the sinking of the caissons for the two main piers. The first caisson for the north pier, as is known, met with an accident when it first grounded and had to be removed and repaired in dry dock. The bottom, as indicated by the borings, was composed of a mass of boulders on the north side and chiefly sand on the south side. In view of the very large size of this caisson (180x55 ft.), it was considered desirable by the Board of Engineers to minimize the chances of further accident as much as possible, and as a consequence, this larger caisson was transferred to the south shore and two separate caissons constructed for the north main pier.

These caissons were floated into position in June, 1911, and were carried to their final location by the end of October, of the same year, the westerly caisson being sunk at the rate of 0.37 ft. per day and the easterly caisson at the rate of 0.47 ft. per day. It was the original intention to sink these caissons to rock, but as the work progressed the sinking became more difficult, and finally, when the caissons had reached an elevation 20 ft. above rock and about 50 ft. below the bed of the river, it was considered that the foundations at this point were quite satisfactory for many times the load that the piers would be called upon to carry.

The foundation at this point was composed almost entirely of large and small boulders firmly wedged together, with only sufficient loose material to fill the interstices. Bearing tests were made on this material, with the result that a load of 59 tons per sq.ft. was carried with a settlement of 1/8 in., practically no settlement at all being noticed at from 20 to 30 tons. As the average working load on the foot of this pier will be only 8 tons per sq.ft., it was considered that there would be no occasion for carrying the foundation to a lower level.

In the sinking of the caisson on the south side, rock was met with for practically the whole depth, and this caisson was carried down to rock. The sinking was started in the latter part of July, 1912, and was completed the latter part of October. The caisson penetrated about 86 ft. below the bed of the river; the average penetration per day was 0.75 ft. The unique feature in the sinking of this caisson was the fact that no load was carried on the cutting edge, the caisson being supported under its bulkheads by means of sandjacks which were lowered simultaneously when the material had been excavated sufficiently under the cutting edge. This was found to work very satisfactorily, and some days the caisson was lowered as much as 24 in., most of the material being excavated by blowpipes.

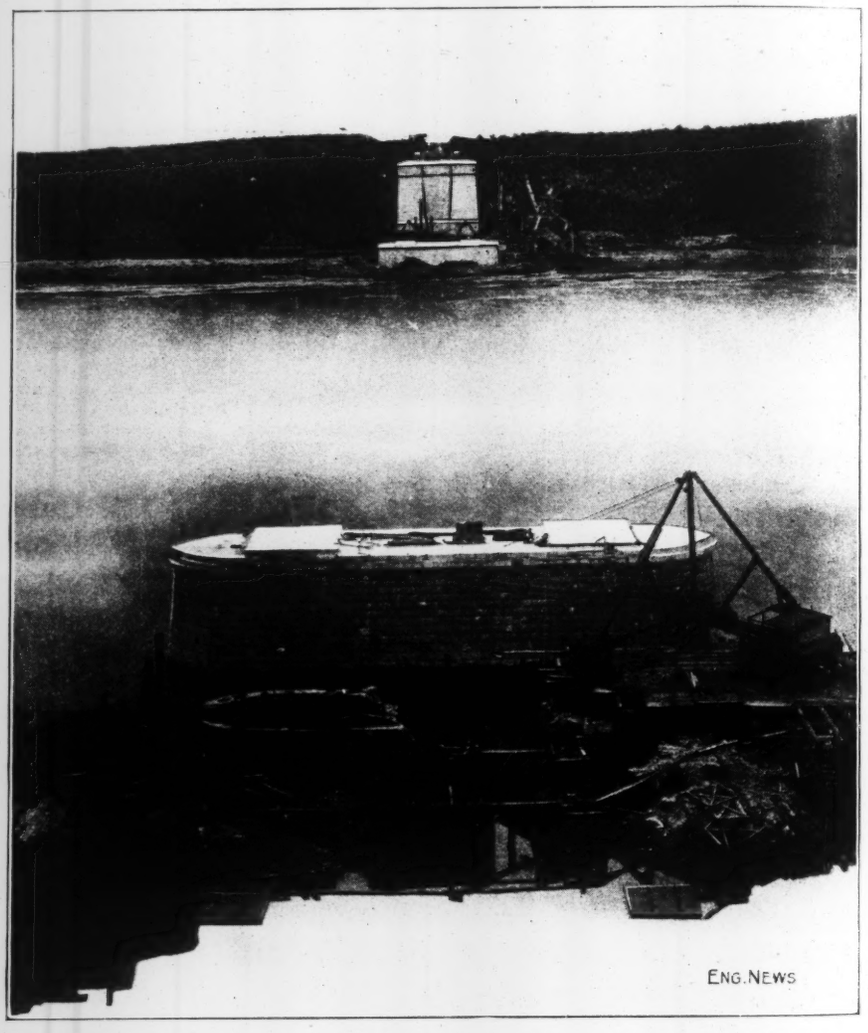


Fig. 1. Completed Substructure of New Quebec Bridge; View from North Anchor Pier

(North main pier in foreground; in front of it is the main pier of the old bridge, being demolished. In the background, south main pier and south anchor pier.)

The total amount of concrete and stonework in the various piers is as follows:

	Cu.yd.
North abutment (alterations)	404
Intermediate pier	1,665
Anchor pier	17,736
Main pier	31,870
South main pier	38,279
Anchor pier	16,073
Abutment (alterations)	61
Total	106,090

*Assistant to Chief Engineer, Board of Engineers, Quebec Bridge; New Birks Bldg., Montreal, Que.

Superstructure

The coming season will see considerable progress on the erection of the superstructure, it being expected that by the end of the present year the greater part of the south anchor arm will have been completed. The two south approach spans between the abutment and the intermediate pier were erected last season.

The work of fabrication has been going on in the shops for the past year and during this time some 8000 to 9000 tons of material—chiefly floor material— have been fabricated and shipped to the site.

Nickel Steel—The superstructure of the bridge is constructed partly of carbon steel and partly of nickel steel. The floor throughout is made of carbon steel, as in many cases the minimum allowable thickness of material governs the section of the member. The truss members of the suspended span are, however, all nickel steel, and the greater part of the cantilever arms. Practically all the anchor arms are carbon steel; the exceptions are a few members where it is necessary to use nickel steel in order to keep the grip of the rivets down to practical limits.

The proportions of the bridge as a whole as well as a large number of the members, constitute a record in bridge construction. The work of designing and erection has little or no precedent to govern it, and had to be worked out entirely independent of any previous experiences.

Principal Dimensions—The bridge provides for two railway tracks and two sidewalks. There is no provision made for highway traffic.

The bridge is 3239 ft. long face to face of abutments, including one 140-ft. approach span on the south end and two spans aggregating 269 ft. on the north end; thus the main cantilever structure is 2830 ft. long, or 30 ft. longer than the old Quebec Bridge. The span between main piers is the same, however—1800 ft. The anchor arms are 515 ft. long, the cantilever arms 580 ft. long, and the suspended span 640 ft. long, center to center of pins. The bridge is 88 ft. wide center to center of trusses. At midspan it has a clear height, above extreme high water, of 150 ft. The trusses are vertical.

The Truss System—The type of truss is of a somewhat unusual design, being of the so called "K" system. This type offers a number of advantages for a bridge of great size, especially during erection. Its chief advantage in this respect is that during the erection of the cantilever arms, it is possible to complete each panel by itself and move the traveler out to the end of the completed portion. This would not be possible with the Warren or single-intersection type without a large number of temporary supports for the members. With this construction, all permanent redundant members for supporting the main members are dispensed with, as every member of the bridge carries live-load with the exception of one small horizontal member at the main post and the supporting trusses carrying the top-chord eye-bars.

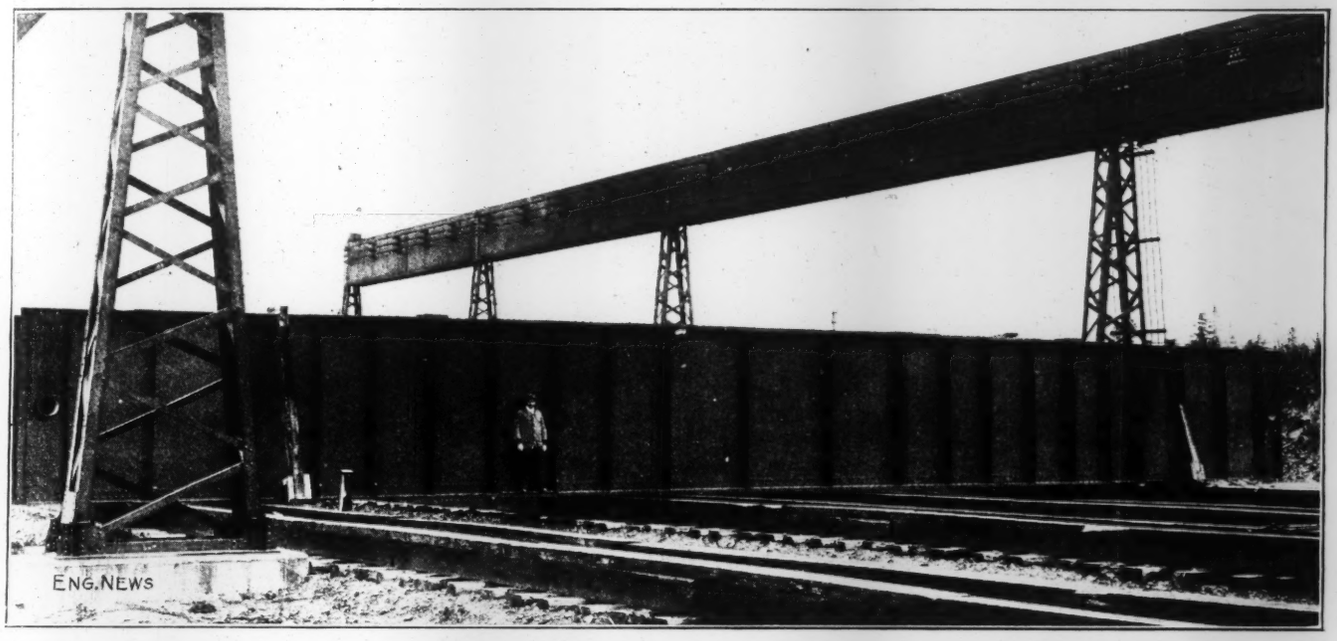


Fig. 2. Half of One of the Double-Web Floor-Beams of Quebec Bridge

(These two I-section halves are shipped separately and connected together in the field. Weight complete, 60 tons. Note the hole for the pin connecting floor-beam to vertical member of truss.)

Makeup of Main Members

The Tension Chord—Carbon-steel eye-bars are used for the top chords of the cantilever and anchor arms. Owing to the large number of bars required, it was found necessary to arrange them in *double rows* (upper and lower) for the entire length of the chord. The heavy section at the main post requires 32 bars $16 \times 2\frac{3}{16}$ in., with a total sectional area of 1129 sq.in. On account of the length between main panel-points, it was found necessary to use *two lengths of eye-bars* between these points. In order to facilitate the work of erection, and also keep the eye-bars properly aligned after erection, these bars are carried on a supporting lattice-truss between panel-points, the trusses remaining permanently in the structure.

All other tension members in the cantilever and anchor arms of the bridge are built-up members. As the eye-bars which would be used for such members

were so entirely out of proportion to the very large compression members in their vicinity, the use of the built-up tension members was justified from an esthetic point of view. In the case of the very long diagonal members, where at least three lengths of eye-bars would be required, the built-up tension members were eminently more desirable as they are able, by means of their flange angles, to support their own weight with little or no deflection. This would not be the case with eye-bars unless supported by auxiliary ties or other redundant members.

The Compression Chord—The lower-chord members are very large. All are composed of four webs tapering in depth by the amount of $3\frac{1}{2}$ in. in 12 in. The largest of these chords is 7 ft. 2 in. deep and 10 ft. 4 in. wide. This member has a cross-section of 1902 sq.in., and its weight between main panel-points is approximately 400 tons. In order to facilitate shipment and erection, however, this member is spliced at the center, and further each of these two sections is divided longitudinally. This brings the weight of the member to be handled down to approximately 100 tons. The pair of webs on each side of the longitudinal center line of the member are shop-riveted together with $8\frac{1}{2}$x1-in. lattice-bars at the top and bottom and a horizontal plate diaphragm at mid-height, and is also held together and squared by transverse plate diaphragms throughout the length of the member.

The webs of these members are, as a rule, composed of four plates to each of the four webs. The maximum thickness of plate used on the webs is 1 in., and the maximum thickness of one web is $3\frac{3}{4}$ in. The question of using thicker plates was considered, but it was felt that, as a rule, better material could be obtained in the thinner gages, and, as stitch-riveting would have to be used in any case, little or no benefit could be derived from the use of the thicker plates. It was also possible to get wider and longer plates in the thinner sizes, and thus reduce the number of shop splices.

Splices—The splices of all compression members are designed with 100% of rivets. This was felt to be preferable in these very large members, taking into consideration the possible uncertainties of getting a true planed surface for the abutting ends.

Main Post—The main post, over the piers, is probably the largest single member of this type ever built into a bridge. It is 310 ft. long center to center of pins and has an unsupported length of 145 ft. It is composed of four separate columns latticed together, its outside dimensions being approximately 9x10 ft. Its greatest cross-section is 1903 sq.in. Each post weighs 1500 tons. For erection purposes it is required to be shipped in 26 sections.

The detail of the top of this post is the heaviest on the bridge, it being required to distribute the stress of five very heavy members. In order to keep the rivet grip within the specification, it was necessary to use nickel steel. This connection is shipped in two pieces, each of which weighs 65 tons.

Main Shoe and Connections—The shoe, under the main posts, has a bearing surface on the masonry of 22 ft. by 26 ft. and is 19 ft. high over all. It is constructed to be shipped and erected in seven pieces, and weighs complete approximately 400 tons. The lower section is composed of four steel castings 4 ft. high, each of which weighs approximately 40 tons. The next section is constructed of plates and shapes and is erected in two pieces. This section takes the thrust from the lower chords of cantilever and anchor arms. The upper section is erected in one piece and carries the two diagonal compression members and the main post.

In order to keep down the thickness of bearing plates in the chord adjoining the shoe, a sleeve is used to distribute the bearing of the pin. This is used for the two chords and the main post. These sleeves have an outside diameter of 45 in., the pins themselves being 30 in. in diameter.

In order to facilitate erection, all pins through members with four webs are in two lengths, there being a separate pin for each two-web section. The 30-in. pins at the shoe and post weigh a little over 6 tons each.

Floor-Beam Connection—Contrary to usual practice, the floor-beams (with one or two exceptions) are not riveted to the vertical posts of the bridge, but are connected by an 11-in. pin passing through the post and the web of the floor-beam. This method of connection was adopted partly to facilitate erection, but principally to do away with the bending in the post that would be caused under full live- and dead-load if a rigid connection were used.

In panels L1 and L2 of both the cantilever and anchor arms it has been necessary to make a rigid connection. In this case, the floor-beam is connected to the post under full dead-load plus half live-load. This means that under dead-load alone the post is under initial bending in one direction, while under full live-load it is subject to equal bending in the other direction.

Floor—At each main panel-point double floor-beams are used, whose webs extend past either side of the tension vertical. At the intermediate panel-points, however, single-web floor-beams are used, supported by means of bangers or posts attached to the intersection of the diagonals.

The floor-beams usually are 10 ft. deep back to back of angles, and weigh complete from 50 to 60 tons. The main stringers are through plate-girders framed with sub-floor-beams and I-beam stringers. The top flange is stiffened laterally with a heavy channel, and gusset plates connect the sub-floor-beams to the webs. By this arrangement it was thought to give an added sense of security to those using the bridge as well as an actual factor of safety in case of derailment.

Wind System—All the wind stresses are transferred to the piers through the bottom lateral bracing, there being no lateral bracing at the top chord. The wind stresses in the web members are carried down the compression members to the bottom chord. There is a separate system of lateral bracing for the floor, which at each main panel-point transfers its stress down through the swaybracing to the bottom lateral system.

The lateral reaction from the wind at the end of the anchor arm is taken care of by means of a steel wind-anchorage embedded in the pier which allows a longitudinal and vertical movement of the truss but no lateral motion.

Traction and Expansion—Traction forces are carried to the bottom laterals through specially designed traction trusses at panel points *AL*1, *CL*1, *AF*9 and *CF*11, at which points there are expansion joints in the floor system.

The expansion of the cantilever arms and suspended span from temperature is taken up at the two ends of

the suspended span. This is effected by means of a specially designed expansion brake. This brake is adjusted to stand a force of 250,000 lb. in either direction.

RIVETS—The size of the rivets varies from 1⅛ in. to ⅞ in. All rivets are carbon steel. The ⅞-in. size is allowed up to 3½-in. grip, the 1-in. size from 3½- to 5½-in. grip, and the 1⅛-in. size for 5½-in. grip and over. The greatest grip of rivets occurs at the field splice of the bottom chord next the shoe, where 9⅞ in. is required. When the grip of the rivet exceeds four diameters, the allowable unit-stress of the rivet is reduced by 1% for each $\frac{1}{16}$ in. of additional grip. This does not apply, however, to compression members having butt joints.

All rivets over 5 in. long have a taper of $\frac{1}{32}$ in. in 12 in. The size under the head is $\frac{1}{32}$ in. smaller than the diameter of the hole.

No material less than ½ in. in thickness is allowed in main members. Material ⅜ in. in thickness is allowed, however, in details, such as lattice bars and tie-plates of the lateral and sway bracing, provided the requirements of the specification as to unsupported length, etc., are fulfilled.

DESIGN LOADING

The bridge is designed for 5000 lb. per lin.ft., covering both entire tracks, with two E60 engines, the engines and train loads being placed to give the maximum condition of loading.

Wind load was assumed at 30 lb. per square foot of exposed surface of the two trusses and 1½ times the elevation of the floor; and 300 lb. per lineal foot as a moving load on exposed surface of the train. A wind load of 30 lb. per sq.ft. *parallel with the bridge* was also assumed acting on one-half the area assumed for normal wind pressure.

In considering temperature stresses, the following conditions were assumed:

Variation of 150° F., on the uniform temperature of the whole structure. A difference of 50° F. between the temperature of steel and masonry. A difference of 25° F. between the temperature of a shaded chord and the average temperature of a chord exposed to the sun. A difference of 25° F. between the outer webs exposed to the sun and the inner webs of compression members.

The substructure was constructed by M. P. and J. T. Davis, of Quebec, under the direction of S. H. Woodard.

The St. Lawrence Bridge Co. is the Contractor for the superstructure; Phelps Johnson is President, G. H. Duggan is Chief Engineer, and G. F. Porter is Engineer of Construction. The work is being supervised by the Board of Engineers Quebec Bridge, composed of C. N. Monsarrat (Chairman and Chief Engineer), C. C. Schneider, and R. Modjeski.

An Early Experimental Pavement--An Interesting Bit of Pavement History

It has been customary to refer to the experimental pavements on Nelson Ave., Columbus, Ohio, those of the United States Office of Public Roads at Ithaca, N. Y., the Second Ave. pavement, New York City, and the Byberry Turnpike, Philadelphia, as pioneer attempts to study the pavement problem "scientifically" by comparing the effects of the same traffic on adjoining strips of different kinds of pavement surfaces. Read the item reprinted below, from the *Civil Engineers and Architects Journal*, London, England, October, 1839, and the old old proverb that "there is nothing new under the sun" inevitably occurs to mind.

THE EXPERIMENTAL PAVING OF OXFORD STREET

The extended time allowed by the Marylebone vestry for testing the durability of the various specimens of experimental paving laid down in Oxford street, having expired on the 3rd ultimo, a large body of members of the Experimental Paving Committee proceeded to Oxford street, for the purpose of entering into a minute examination of the specimens, prior to completing their final report and recommendation to the vestry as to the plan which it would be most advisable to adopt. The blocks of granite laid down, and the interstices of which were filled up with Claridge's Asphalte, were found to be in excellent condition, as was also the granite laid down by the parish and grouted together. The Bastenne Guajac bitumen had stood the test of wear occasioned by the great number of vehicles passing through this extensive thoroughfare in a surprising manner, but at parts where the traffic is most severe, here and there, slight ruts are perceptible. On arriving at the wooden blocks, the surface was found as smooth and even as when first laid down. Five of the blocks were taken up and minutely examined by the Committee and one of them split to pieces for the purpose of discovering if any symptoms of decay had made its appearance, but the wood was found to be perfectly sound, and the diminution of the length of the blocks [evidently means height] (12 in.), notwithstanding the immense weight of vehicles continuously passing over them, was scarcely perceptible. Having completed their survey of the road, the Committee adjourned to the Court-house for the purpose of deliberating as to the best mode to be adopted, when a long discussion ensued upon the subject. Mr. Kensett supported the adoption of the wood, and Mr. Harbutt and several others opposed it on the ground that the material was of too slippery a nature for horses. After a variety of arguments in the course of which three or four amendments were put and negatived, the following resolution was put and carried—viz. "That it appears to the Committee that wooden block paving has proved itself equal to the traffic and paving of the whole of Oxford street, and it is, therefore, resolved to recommend to the vestry to adopt the wooden block paving for the thoroughfare, subject to certain conditions and regulations." The greatest interest is manifest on this subject in Marylebone.

This item is of much interest for another reason. It is, so far as we can determine, the first mention of a bituminous pavement laid in London. Tillson in his "Street Pavements and Paving Materials" (1912) states (p. 8):

A sample of asphalt macadam was laid on the road between Bordeaux and Rouen in 1840. This was a mixture of asphaltic rock and ordinary stone, and was probably the first bituminous roadway laid on a public highway, although about the same time asphaltic rock was used for sidewalks on some of the streets of Paris.

We are unable to determine the nature of the "Bastenne guajac bitumen" pavement, but the context shows clearly that it was a kind of asphaltic pavement.

A subsequent issue of the same periodical contains a note to the effect that wood block was ultimately adopted for the whole of Oxford St. after an acrimonious controversy between the advocates of the wood block and the advocates of the granite block. Moreover, this was the first real triumph of wood-block pavement in London. Its adoption for Oxford St. led to the formation of a local "pavement improvement" society, whose sole object was to make an impartial study of different pavements to discover that phantom, for which the general public still seeks—the universal pavement.

Fifty-Thousand-Dollar Verdict for Injured Miner—A premature explosion in one of the Delaware, Lackawanna & Western R.R. coal mines at Luzerne, Penn., severely injured Matt Yarkanis, a miner. The railroad was charged with negligence; and the verdict of the jury in the Federal District Court of Brooklyn, N. Y., on Apr. 4, granted Yarkanis $50,000 damages. The plaintiff asked for $75,000.

The Narrows Siphon of the Catskill Aqueduct

One of the most interesting, difficult and costly pieces of submarine pipe laying ever undertaken has recently been put under construction for the Board of Water Supply of the City of New York. The pipe will convey Catskill Aqueduct water from Brooklyn borough to Richmond borough, beneath the Narrows and the great ship channel to the Port of New York. This submarine "inverted siphon" will be of 36-in. cast-iron pipe, about 9800 ft. long, and will be provided with flexible joints of special design. The maximum depth of water is about 60 ft. and the greatest depth of the bottom of the pipe below the water surface will be about 72 ft., the pipe being laid in a trench, with 8 ft. of cover. Besides the submarine pipe, the contract includes some 950 lin.ft. of 36- and 18-in. hub-and-spigot pipe and specials, weigning about 335 tons, and two 36-in. Venturi meters. The submarine pipe will weigh about 3800 tons. There will be 600,000 cu.yd. of submarine excavation; 125,000 cu.yd. of submarine trench refilled with material from the harbor bottom and another 125,000 cu.yd. of refill with selected material not from the harbor bottom, the latter to be of such nature as to offer great resistance to the penetration of anchors. Owing to the nature of the work, the quantities given for excavation and refill are only rough approximations.

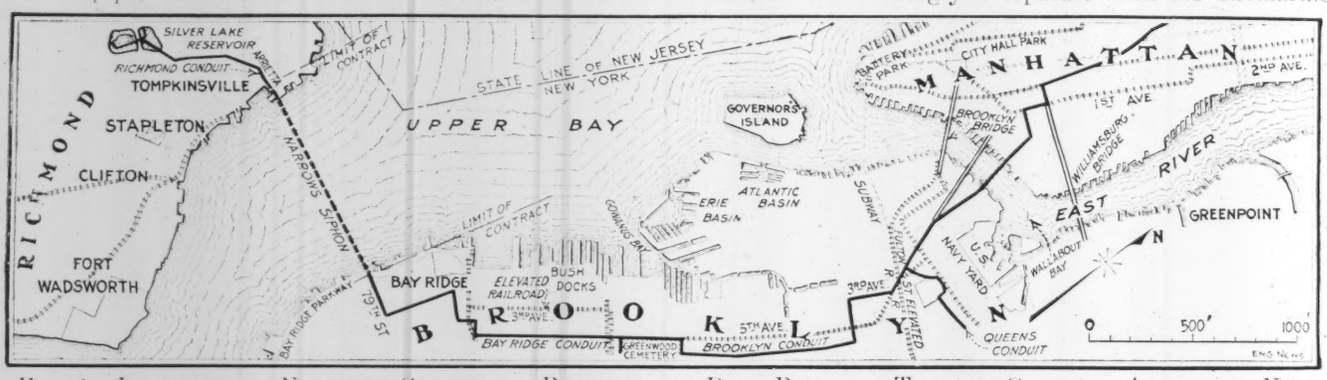


FIG. 1. LOCATION OF NARROWS SIPHON IN RELATION TO DEEP PRESSURE TUNNEL, CATSKILL AQUEDUCT, NEW YORK CITY

(The "conduits" are 66-in. steel and 48-in. cast-iron pipes.)

Bids for the work just outlined were received on Jan. 27, 1914 (see Construction News section of this journal for Jan. 29, 1914, p. 68, for details). The bids ranged from $1,590,000 to $996,862. The last named figure was the bid of the Merritt & Chapman Derrick & Wrecking Co., 17 Battery Place, New York City, to whom the contract was awarded on Mar. 2, 1914. This company has sublet the contract for supplying the flexible-jointed pipe to the Westinghouse Machine Co., of East Pittsburgh, Penn., which will cast the pipe at its Trafford City foundry, and will do the machine work at its East Pittsburgh plant.

A map and profile of the siphon is here reproduced from the contract drawings as Figs. 1 and 2. The map shows the relation of the siphon to the deep-pressure tunnel and the pipe conduits of the Catskill Aqueduct, beneath New York City, the East River and Brooklyn, at one end, and its connection with a 48-in. pipe line leading to the Silver Lake Reservoir on Staten Island (see ENG. NEWS, Feb. 5, 1914, for description of reservoir).

The large volume of shipping passing the Narrows, the currents and the great water depth are among the many difficulties which will be encountered in this work. The contractor will not be allowed to obstruct more than 1000 ft. of the channel at any one time.

Fig. 3 shows the type of flexible joint devised by the Board of Water Supply for this work after various tests (but with some revisions dated Apr. 7). Fig. 4 shows the apparatus used by the Board in making its experimental tests of the tightness of the joints, which it is expected, will be used also during submarine pipe-laying to prove each joint before it is submerged. The Board's tests, with pressures up to 200 lb. per sq.in., indicated "that the proposed type of flexible joint will produce an acceptably tight pipe-line *without submarine calking* except at a few places where some unusual condition has obtained." Accordingly a separate item for submarine calking was inserted for bidders in order to give the city the advantage if little calking is required, while at the same time protecting the contractor.

The following extracts from the specifications will be of unusual interest in view of the character and magnitude of the work:

EXTRACTS FROM SPECIFICATIONS FOR 36-IN. FLEXIBLE PIPE FOR THE NARROWS, NEW YORK CITY

DESCRIPTION OF PIPE AND JOINTS—SEC. 1.2 — The pipes shall be made of cast iron with flexible joints of the design shown on the contract drawings, unless another design submitted by the Contractor be approved. If the design shown on the contract drawings be used, minor changes in details may be ordered or approved. The essential features

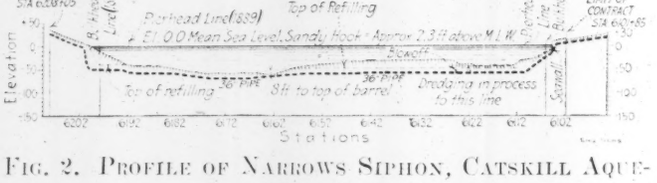


FIG. 2. PROFILE OF NARROWS SIPHON, CATSKILL AQUEDUCT, NEW YORK CITY

(Sixteen borings, not shown on profile, were made, all but one being carried to Elev. 100 or slightly deeper. Blow-offs are proposed near Stations 6192, 6172 and 6122, for use during construction, if found necessary.)

of this joint are a spherical bell turned on the interior and reinforced by a band of wrought iron or steel shrunk or pressed on; and a spigot, having deep grooves for the retention of the lead and a narrow turned collar to bear on the bell in order to insure uniform lead space and carry the weight. The pipes shall be straight and shall be truly circular in section, with their inner and outer surfaces concentric and shall be 36 in. in inside diameter. The average laying length of these pipes shall be at least 12 ft., not including a number of pipes, not exceeding 25, which may be ordered approxi-

...ly 6 ft. in laying length. One or more of these short ... shall, if ordered, have two bells each.

...EC. 1.7—All pipes shall be made of cast iron with as low a ...rcentage of graphitic carbon as is consistent with safe ...gth, toughness and shrinkage of these castings. . . .

...EC. 1.13—A wrought-iron or steel band shall be shrunk ...pressed on to the bell end of each side. Wrought iron ... in this band shall conform to the standard specifications ... the American Society for Testing Materials for refined

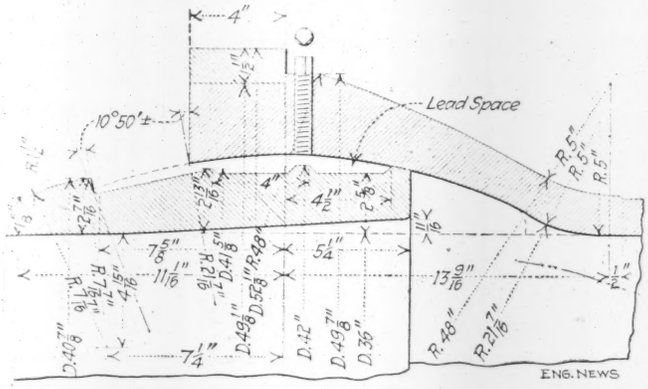


FIG. 3. FLEXIBLE JOINT FOR 36-IN. SUBMERGED CAST-IRON PIPE, NARROWS SIPHON

(The standard weights for a 12-ft. laying length of bell and spigot pipe would be 9080 lb.; for a 6-ft. length of the same, 5480 lb.; for a 6-ft. length of 2-bell pipe, 6180 lb. There would be approximately 280 lb. of lead per joint. The 16 gib screws per bell would have a total weight of 7 lb.)

wrought-iron bars, adopted August, 1913. Unless otherwise approved, the band shall be rolled on a tire mill. Steel, if used in this band, shall conform to the specifications of the American Society for Testing Materials for steel tires Class (A), driving tires for passenger engines, adopted August, 1913. Both the interior surface of the band and the exterior surface of the band-seat shall be turned truly conical, with a total taper of $\frac{3}{32}$ in. The diameter of band-seat is to be greater than the interior diameter of band by not less than 0.010 in. nor more than 0.015 in. The inner corner of each band shall be rounded, and the corresponding corner of the casting filleted, with a clearance as shown.

SEC. 1.14—The inner surface of the bell and the surface of the spigot collar which is to come in contact with the bell shall be turned truly spherical, and no pipe will be accepted which differs in these parts by more than 0.01 in. from a true sphere. There shall be no depressions in the machined inner surfaces of the bells and they shall be free from chatter marks and rough tool cuts. The machine work shall be done on machines in good adjustment, acceptably suited to the purpose. Finished pipes shall be interchangeable. The required accuracy of machine work is important and will be insisted upon. Finished inner surfaces of all spherical bells shall be smooth. Machined surfaces shall be protected by a coating of white lead and tallow or other approved substance.

COATING—SEC. 1.15—Each pipe shall be coated inside and outside with bitumastic solution and bitumastic enamel, applied by the American Bitumastic Enamels Co. No coating, however, shall be applied to the machined spherical surface inside the bell, nor, until directed, to the outside of the spigot beyond the bearing shoulder which is provided to limit the deflection of the joint. At the foundry, after the pipe shall have been inspected, cleaned, tested, the wrought-iron or steel band put on, all rust removed by wire brushing, and all grease, oil and paint taken off by means of an approved chemical "remover," both interior and exterior surfaces shall receive one good coat of bitumastic solution. After delivery, and as short a time as practicable before laying, each pipe shall be given a second good coat of bitumastic solution and immediately thereafter a heavy coat of bitumastic enamel. The solution and the enamel shall each be carefully applied, so as to cover absolutely all the surfaces of the pipe excepting the surfaces above mentioned. Inside the pipe care shall be exercised to make the coating as smooth as possible and to have such brush marks as may be unavoidable parallel to the axis of the pipe. The enamel shall be of such consistence that it will not scale off when struck a sharp blow with a hardwood instrument nor run when the pipe is exposed to the sun. The consistence of the coating shall be varied as found necessary with the seasonal changes of temperature. The coating as finished shall be free from air bubbles and all other imperfections and nowhere less than $\frac{1}{32}$ in. thick. After each pipe is placed in the line and its joint made, the exposed uncoated portions at the joint shall be coated like the remainder of the pipe and any parts of the coating which may have been injured shall be repaired with enamel or enamel and solution, so as to leave the coating in perfect condition when the pipe is submerged. These final repairs of the coatings shall include the heads and nuts, if any, of bolts, gib screws and similar parts. Any pipe which at any time may be found unsatisfactorily coated, shall be thoroughly cleaned in whole or in part as directed and recoated to the extent ordered. Care shall be taken in handling the pipes not to injure the coating, and no pipes or other material of any kind shall be placed in the pipes during transportation or at any time after they have been coated. When the pipe is ready for submerging there shall be no uncoated exposed iron surfaces of the pipe or its appurtenances. A letter from the American Bitumastic Enamels Co. quoting price for the coating herein specified may be seen in the office of the Engineer.

SEC. 1.16—Before the first coat of bitumastic solution shall have been applied, and before or after machining, as may be convenient in the process of pipe making, each pipe shall be subjected to a proof by a hydrostatic pressure of 350 lb. per sq.in., and to a hammer test while under this pressure. Ample time shall be given for a careful surface inspection while the pipe is under test pressure.

METHOD OF LAYING PIPE AND TESTING JOINTS—SEC. 7.2—The pipes shall be assembled on the pipe-laying barge, and as successive pipes are added, the pipe-line shall be permitted to sink to the bottom of the trench, the open end being constantly and firmly secured to the barge, and kept above water. To guide the pipe-line and support the newly added pipes while joints are being made and tested, a satisfactorily designed and constructed strong cradle, or launchway, of steel or steel and timber, shall be provided on the pipe-laying barge, extending to the bottom of the excavation, at such slope as will not cause greater deflections in the pipe joints than will be approved. This cradle may be required to have at its lower end a scraper which will acceptably clear and smooth the trench bottom immediately before the pipe is lowered thereon. At the barge the cradle shall be supported by means of a device having sliding and swivel joints and springs, or by other approved means, which

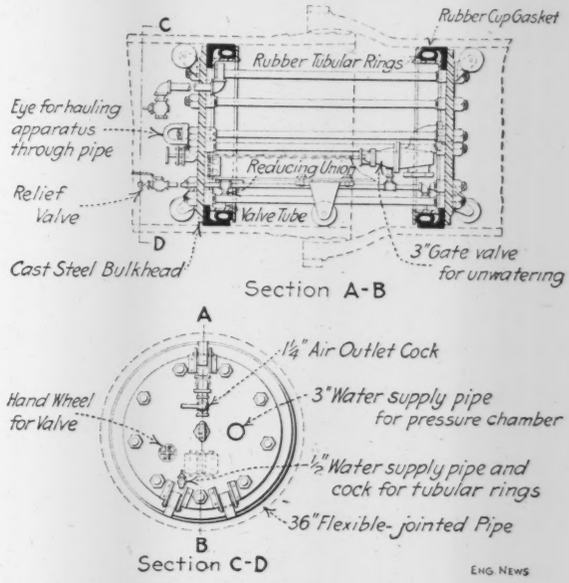


FIG. 4. APPARATUS FOR TESTING JOINTS IN 36-IN. FLEXIBLE-JOINTED PIPE

will minimize the motion of the hanging portion of the pipe-line. Great care shall be exercised during pipe-laying to prevent at any time a deflection at any joint in excess of 10°. A few 6-ft. lengths of pipe shall be used, if required, for the sharper vertical curves near the shores. Barges shall be securely anchored with wire cables or chains and very large anchors so as to prevent an undue stress coming upon the pipe-line, especially during storms and the passing of large vessels. The barge shall be of such shape and size and so ballasted as to be steady as possible in waves caused by passing vessels or by storms.

SEC. 7.3—Before making a joint the pipes to be connected shall be in a straight line or at such angle (for the pipe at considerable changes of slope), as the Engineer may direct.

Both the inside surface of the bell and the outside of the spigot shall be thoroughly cleaned and dried, the white lead and tallow or other coating and rust, if any, being removed from machined surfaces. The spigot shall be held in the bell in such a manner as to give a uniform lead space and have a firm bearing between the finished collar on the spigot and the inner surface of the bell. The joints shall then be run solid at one pouring with soft pig lead of acceptable quality, which has been melted and heated to such a temperature as to insure a thorough filling of the joint. The melting pot shall be close to the joint and have sufficient capacity to pour the entire joint at one operation. Care shall be exercised to prevent the accumulation of dross in the melting pot. After a joint has been poured full of lead, the gib screws or tap bolts around the bell shall be removed and a stiff mixture of graphite and thick mineral grease, or other approved lubricant, injected into the shrinkage space between the lead and the iron, in the quantity directed. Soft lead plugs about ½ in. in diameter and 1 in. long, shall then be forced into the holes in the manner directed or approved, by means of the gib screws, to the number necessary to make a joint which will remain watertight after being deflected 10° in any direction. Mechanical means for removing and inserting the gib screws rapidly shall be provided, or the Contractor may substitute another satisfactory and expeditious device for injecting the lead plugs. However this operation is performed, care shall be exercised to avoid undue and unsymmetrical stressing of the pipe bell, and to leave no projections which will mar the lead in the joint, during subsequent movement of the pipe, so as to cause leakage. At the completion of the joint, the gib screws shall be left in the holes, or the holes shall be otherwise acceptably plugged, as directed. As completed each joint shall be wholly watertight.

SEC. 7.4—Immediately after its completion and before submergence, each pipe joint shall be thoroughly tested to a hydrostatic pressure of 200 lb. per sq.in., maintained for not less than 10 minutes, using special machines for this purpose, one of which not wholly complete will be furnished by the City. This machine may be improved by the Contractor as experience may indicate, or other satisfactory device substituted. He shall furnish the rubber tubular rings and other parts shown on the drawings or ordered necessary to put it into satisfactory working condition, and shall replace parts as worn or injured by use. A second, and, if pipe-laying be done at two places, a third, similar machine shall be provided by the Contractor so that testing may be done without interruption or delay to pipe-laying, one testing machine in good condition being always kept in reserve. After each test is completed, the testing machine shall be drawn up and removed from the pipe if necessary so as to permit the placing of the next pipe. Suitable apparatus shall be installed for so handling the testing machine without injury to it or to the pipe. Especial care shall be taken of the pipe coating. If any joint leaks under test, it shall be made watertight by forcing in additional lead plugs or by such other means as ordered. Either before or after this test or during its progress the Contractor may be required to deflect the pipe not to exceed 10 degrees in any direction to demonstrate its flexibility with or without pressure.

SEC. 7.5—In order to aid the Engineer in determining whether an acceptably watertight pipe-line can be secured by the use of the type of submarine joint shown on the contract drawings, without submarine calking, the Contractor shall make a hydrostatic test of the portion of the line first laid, after not less than 500 ft. nor more than 600 ft. shall have been lowered to the bottom of the trench. As pipe laying progresses, at ordered intervals not less than 500 nor more than 1000 ft., the pipeline shall be tested by hydrostatic pressure not less than 130 lb. per sq.in. as shown by a gage not above Elevation 20, maintained for 30 minutes, unless in any case an air test made under Item 9 or 10 renders a hydrostatic test unnecessary.

SEC. 7.6—A 4-in. blow-off pipe and valves, as shown on Sheet H, or an equivalent satisfactory device, shall be placed in the 36-in. pipe at each of three or four low points as directed, and operated by diver or otherwise so as to permit complete drainage of water from the pipe-line, by the aid of compressed air, if required for any purpose. At the times directed, the submarine blow-offs, if used, shall be removed and the holes in the pipe-line tightly stopped with approved iron plugs well screwed in. At the completion of the work, the blow-off valves and pipes shall be the property of the Contractor.

SEC. 7.8—The Contractor may begin the laying of submarine pipe on the Brooklyn shore, or, if permitted by the authorities having jurisdiction, may begin at a central point and work toward the two shores with two outfits. . . . . .

J. Waldo Smith is Chief Engineer of the Board of Water Supply; Merritt H. Smith, Deputy Chief Engineer; Alfred D. Flinn, Department Engineer of Headquarters, and Walter E. Spear, City Aqueduct Department Engineer.

Supervising the Execution of Large Percentage Contracts to Protect the Clients' Interests

By G. G. Ommanney*

The "percentage" type of contract, wherein the contractor's compensation is based upon an agreed percentage of the actual cost of work with sometimes a bonus or forfeiture clause attached involving an agreed proportion of the amount whereby the final cost of the job comes under or exceeds a certain estimated figure, is becoming a popular basis upon which to execute large works, and, where reliable firms are involved, has been found to work satisfactorily to all parties.

The young engineer may find himself placed in charge of work, on behalf of a railroad company or large corporation which has let a contract on these terms. It is no part of his duty to take into account the standing or reliability of the contractors employed. He is there in the interest of his employers (1) and it is for him so to organize his work that he may, with discretion and without friction, be in a position to check up and vouch for all expenditures connected with the work.

This form of contract being somewhat of an innovation, (2) he will frequently find at his head office, (3) but vague ideas as to how such work may be best handled to safeguard the clients' interests.

Where the firm of contractors employed has not previously been entrusted with work on a similar basis of payment, it will be particularly (5) desirable to have an efficient check on expenditures; and a responsible contractor will, in his own interests, be glad to have such a check placed upon him.

As the outcome of considerable experience the writer has made the following notes on what he believes to be the proper method of attaining the above object and which he thinks may be of assistance and interest to engineers who have to supervise this kind of contracts (6).

"Engineer" means the Engineer in charge of the job throughout and not some head-office official unfamiliar with conditions as they exist on the ground.

Material

(1) The contractor must requisition the Purchasing Agent for all orders above a certain value (say $200). The Purchasing Agent should not accept requisitions unless O.K'd by the Engineer.

In order to check these requisitions, the Engineer should have a duplicate of the contractor's building book, summarizing all items of material required for each portion of the work and referring to the blueprints involved.

If it is necessary for the contractor to purchase all material, he must, before placing an order, submit all names of firms tendering and prices quoted to the Engineer (who has previously approved the requisition) with a recommendation as to placing the order. The order will not be placed without the Engineer's approval.

*Special Engineer to the President, Can. Pac. Ry., Montreal, Can.

As stated above, it is better that the purchasing be done by a head-office purchasing agent in employ of the client, thus relieving the Engineer of a lot of office routine work.

(2) The contractor must submit to the Engineer all competitive bids before letting any subcontract. He must attach his recommendation for the Engineer's approval.

(3) Small items of material purchased by the contractor will be covered by a statement submitted to the Engineer at time of each payroll. Against each item of this statement will be marked the job for which it was required. Vouchers for each disbursement will be attached and will be initialed:

(a) By Contractor's Superintendent as necessary for the work.

(b) By Contractor's Cashier (correct as to price).

(c) By Contractor's Storekeeper (received at store).

(4) The contractor must furnish a daily report to the Engineer of material received, and used in the work, supplemented by a statement at time of each payroll showing totals (to date and for period since previous statement) of material received, on hand and used in work.

(5) Estimates for payments to the contractor will be based on material actually used. This the Engineer much check up for himself from building book, blueprints or Inspector's reports. He may estimate percentages of subcontracts completed.

(6) All invoices for material purchased by Purchasing Agent (or the contractor) will go to the Engineer for certification and distribution and will be entered by him under each job subdivided under various headings such as "foundations," "wharf substructures," "power plant," etc.; labor classifications will, in general, correspond to these subheadings.

Where buying is done by the Purchasing Agent, the Engineer should be notified whenever an order is placed so that he may always be able to estimate value of material used and will know how material is coming; this enables him to make reliable programs of progress, get after delayed material and generally help in pushing the work forward.

Labor

(1) The contractor must agree with the Engineer as to all rates to be paid.

(2) The Contractor must agree with the Engineer as to what classifications will be kept and the system for keeping same.

(3) The contractor must submit to the Engineer a daily report made up from timekeeper's returns of force distributed under the several classification numbers.

(4) Every payroll will go to the Engineer for his signature before going to the head office, and with it the contractor will submit a monthly summary of classification distributions.

The payroll must show the signature of every man employed.

The Engineer will send in to the head office a summarized estimate with each payroll showing amount due contractors on material used, labor and small disbursements.

It is well to arrange for a weekly meeting in the Engineer's office at which most of the above business may be transacted, methods and procedure discussed with the contractor, such as larger questions relating to methods of forming, excavation, etc., tenders considered, etc. A stenographer should record all decisions made at these meetings and the original record should be initialed by all parties interested.

The Engineer will have the following staff: If he is responsible for laying out the work he will have (1) an Instrument-man and Rodman. Chainmen can be picked from intelligent laborers on the job. The Instrument-man will assist in taking quantities from building books and blueprints, making estimates, etc.

(2) Competent Inspectors (one or two according to the size of the job). Their duties will be to give the Engineer a daily report of work done and approximate material and plant used. They should refer any questions of faulty workmanship, extravagant methods, etc., to the Engineer, who will take them up with the contractor. They should have authority to stop any work at any time pending decision of the Engineer.

(3) A Time-keeper who will twice a day check time (independently of the contractor's time-keeper) and make a rough classification. This man will keep a general eye on material coming in. He will keep a record of cars going and coming and a list of plant in use, removed, etc., occasionally checking up the contractor's returns of material received and on hand.

(4) A competent clerk to enter up invoices certified and labor charges under the various distributions. This man should look after all office files and be able to take quantities off blueprints and building book. On a big job, the clerk may have under him a stenographer and office boy.

The Engineer should be largely free to supervise, discuss with the contractors, procedure, methods, etc. No departure from plans or specifications should be permitted without his written consent. He will have enough to do and can materially help the progress of the job attending to the innumerable matters that daily come up for decision rather than in making out reports in his office or doing instrument and other detail work.

The Engineer may at any time ask the contractor to furnish an estimate of what any portion of the work will be likely to cost. This must be furnished promptly.

All details of specifications and plans should be settled before the contract is awarded, so that this demand for estimates should be made with discretion; at the same time it furnishes a means whereby a contractor will be compelled to study economy and may also lead to modifications and savings in design and specifications.

A Commission-Plan Charter for Buffalo, N. Y., will, if approved by popular vote in November, 1914, go into effect on Jan. 1, 1916. The commission or council will consist of a mayor at $8000 and four other councilmen at $7000 a year, serving four-year terms. The mayor will be elected as such and by virtue of his office will become head of (1) the Department of Public Safety. The council will decide which one of its four ordinary members shall be head of the departments of (2) finance and accounts, (3) public affairs, (4) public works and (5) parks and buildings. The whole council will perform the duties falling by general law upon boards of health, but the council may by resolution delegate these powers to either the mayor or to a commissioner of health. Several years ago a "public opinion" vote taken in Buffalo was heavily in favor of the commission plan, but the plan failed to secure legislative sanction until this year. Even then it was vetoed by the mayor, but it was passed over his veto by the legislature and approved by the governor.

The Rangoon River Training Wall, Rangoon, Burmah

A river-control work of unprecedented size has just been completed in the construction of a training wall on the Rangoon River opposite the Port of Rangoon, Burmah, India. The wall is 2 mi. long and has been built in order to prevent the Rangoon River, which is an offshoot of the Irrawaddy, taking a new course and leaving the town and port of Rangoon. The wall had to cross the main channel of the river, and the average depth of the foundation is 58 ft. below high-water level. It is 235

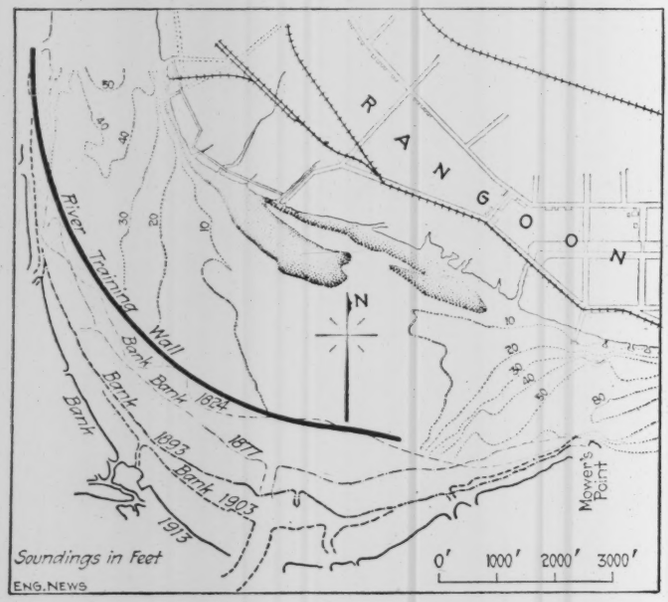


FIG. 1. THE RANGOON RIVER AT RANGOON, SHOWING SHORE CONDITIONS, 1824-1913, AND THE NEW TRAINING WALL

ft. wide at the base, and is founded on brushwood mattresses 120 ft. long by 80 ft. broad by 3 ft. thick, made on shore, towed to the site, and sunk. In the construction, 6,000,000 bundles of brushwood and 1½ million tons of granite have been used. The total cost of the work approximates £1,000,000. We have received a description of the wall from George C. Buchanan, who is Chairman and Chief Engineer of the Rangoon Port Commissioners, and who has been in charge of this immense work since its initiation. From this description we have prepared the following article.

DESIGN

The Rangoon River is formed by the junction of the Hlaing and Panhlaing Rivers, 5 mi. above the City of Rangoon. The former is a swift-flowing and short river, whereas the latter, an offshoot of the great Irrawaddy, is rather sluggish but of large volume. The mean discharge of the river above the town throughout all tides during the year is about 300,000 cu.ft. per sec., with a mean velocity of 4 ft. per sec. Immediately above the town, the river takes a right-angle bend and the change of direction is so abrupt that it has caused an erosion of the right or concave bank and the formation of a deep pool.

There is no record to show when this erosion commenced, but it is probable that it began in the early '50's of the last century. A plan of the Rangoon River of 1824 shows the river at normal width. The accompanying Fig. 1 gives the bank of the river at that time and shows the encroachment during the past century. In the opinion of the engineers connected with the work there was at one time a great deal more of water flowing down the upper branches of the river than at present, and the resultant force caused by the junction of the Hlaing and Panhlaing Rivers infringed on and eroded the left bank until an obstacle was encountered. The main stream was then diverted to the right bank, where it found an easily eroded material, and steady erosion has continued to the present time. This erosion was prevented from going farther downstream by a natural projection just below the city.

The deep-water channel above Rangoon has been diverted year by year farther away from the Rangoon foreshore, and large sand banks have formed on the Rangoon side of the river, immediately above the town. The ebb tide, swinging around the eroded bend in a deep contracted channel, has emerged from it at Mower's Point (Fig. 1), and the momentum thus given to the water has carried it obliquely across the river to the Rangoon bank, causing erosion there and tending to undermine the wharfs and piers, and causing conditions of current which have seriously impeded the landing of vessels.

Since 1880, various projects have been brought forward for controlling the river, but it was not until 1903 that a suitable scheme was suggested. It is to be realized that the river here is a great tidal basin varying from half a mile to a mile wide, situated in an alluvial plain with depths of water up to 80 ft. below low water, a 20-ft. range of tide, and currents on the flood and ebb running 5 to 7 mi. per hour. In 1903, Mr. Buchanan proposed the scheme which has since been carried out, but considerable opposition arose to his proposition to found the wall on brush mattresses. This opposition was overcome, and in 1907 work commenced. Fig. 1 shows the outline of the wall, and Fig. 2 the cross-section of its normal section.

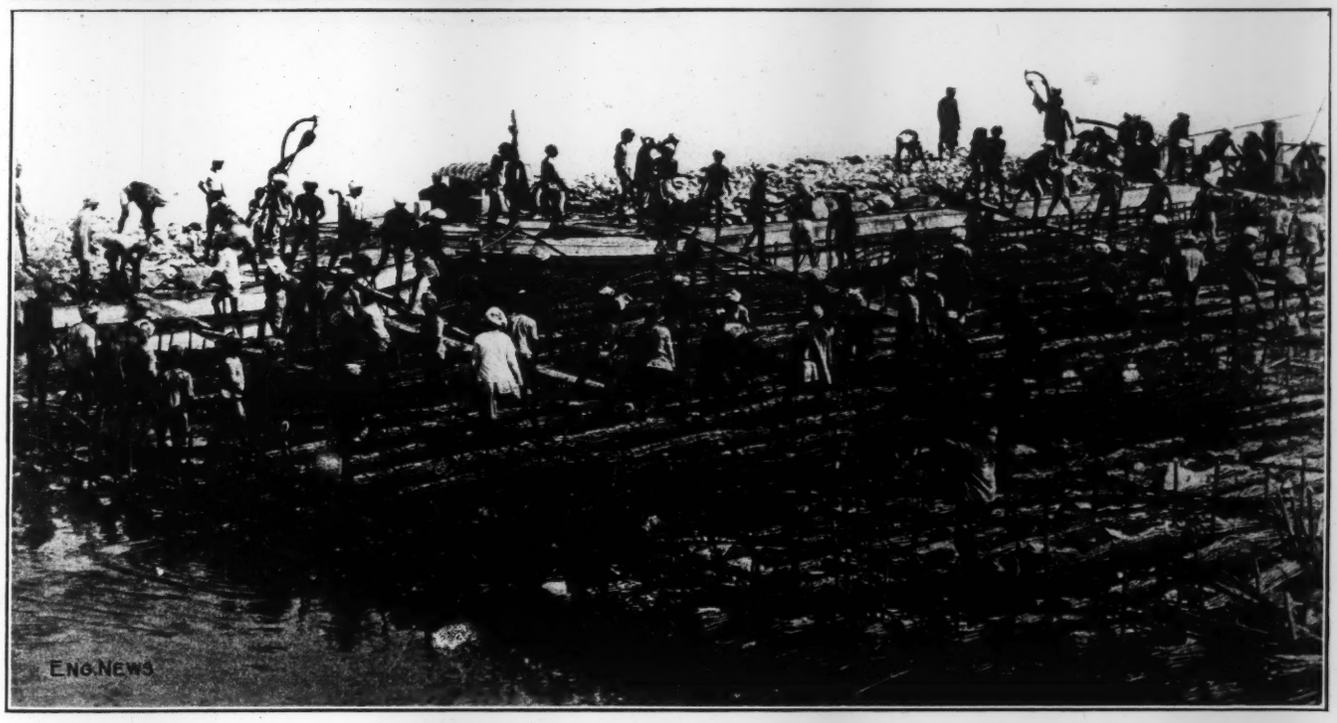
The work to be done consisted of the construction of the training wall, about 2 mi. long, and the dredging of the channel in front of the wall through the shoals to accommodate the diverted channel. The wall was constructed of rubble stone, dumped from hoppers or deposited by hand from barges, on a foundation of brushwood mattresses, overlaid with rubble uniformly distrib-

FIG. 2. TYPICAL SECTION THROUGH THE RANGOON TRAINING WALL

uted. The average depth of water on the site of the foundation before work was begun was 50 ft. at high water, and the top of the wall was 104 ft. above datum at Rangoon, which is about high water in neap tide. After a part of the wall had been built, it was found that this height was not sufficient to keep the waves from breaking over the wall, so an additional height of 9 ft. was made in three lifts of 3 ft. each between concrete slabs tied together with steel rods and filled in with broken stone.

The wall at its beginning is tangent to high-water

ark. It sweeps southward and eastward in a curve of 30-ft. radius for a distance of 8500 ft., after which it kes a straight course approximately parallel to the bank the river. The direction of the straight portion is so ligned as to cut through Mower's Point in line with the ight bank of the river opposite Rangoon, so that when he point is removed there will be a straight channel of uniform width opposite the town. The river bed along



FIGS. 3-4. MAKING THE BRUSH MATTRESS ON SHORE (ABOVE) AND PLACING THE FIRST LOADING OF STONE (BELOW)

the line of the wall consists of a layer of fine sand and silt varying from 6 to 10 ft. in thickness, overlying a bed of hard sand and gravel. The high-water area of the portion of the river bed between the present right bank and the wall is about 300 acres. This area is now rapidly filling up, and will very soon be reclaimed so as to be available for trade purposes.

CONSTRUCTION

After considering the desirability of letting the work on contract, it was decided that it had better be done by day labor under the direction of the Port engineers. Four separate operations were required in the construction of the wall: (1) quarrying the stone; (2) making and sinking the mattresses; (3) dumping the stone, and (4) building the concrete-retained top filling.

QUARRY—The stone to be quarried, about 1,500,000 tons, was taken from Kalagouk, an uninhabited island about 135 miles from Rangoon. The quarry at this place was described in ENGINEERING NEWS, Dec. 8, 1910, p. 618. A colony of over a thousand natives and a number of English engineers was established on the island, and work there continued through a period of over three years. Stone was quarried near the shore, conveyed to barges far off shore in cableways, and transported the 135 miles in steam barges. On arrival at Rangoon, the steamer proceeded to the site of the work, and after taking on board one of the resident engineers, was maneuvered over the exact position where the stone was required, when at a signal the doors in the bottom were opened and the whole thousand tons dumped in position.

MATTRESS WORK—Previous to the dumping of the stone, however, a brush mattress 235 ft. wide had to be laid along the line of the training wall. The object of the mattress was to form a carpet or temporary foundation extending the whole length of the wall, on which the stone forming the apron and wall could be easily distributed. Without this carpet, each individual load of stone deposited would have quickly sunk into the silt. Eddies would have been formed around the heaps of stone, which would have probably continued sinking, until the maximum depth of scour had been reached, thus increasing vastly the total amount of stone required. The reason for the great width of the carpet was that when covered with stone it should form an apron to protect the main wall from being undermined by scour.

Each mattress was 125 ft. long and either 75 or 80 ft. broad, and 3 ft. thick, and contained 20,000 to 22,000 bundles of brushwood. Each was constructed to combine strength with flexibility, and in that respect the mattresses answered their purpose admirably. They were built on specially constructed slipways (Fig. 3), and had to be made at low water while the slipways were uncovered. The average time taken to complete one was seven working hours, but in emergency it could be finished in five hours. As the accompanying views show, a great number of men were used in the construction of these mattresses, labor being very cheap. From 250 to 300 men were employed on each one.

The mattresses were towed into position by a steam tug, and to prevent them from dipping under water and so offering a great resistance to towing, a float or boom of bamboo was placed under the forward edge. This float was pulled out by the tug as soon as the mattress arrived opposite. The method of mooring and sinking was as follows: Four circular pontoons were moored into position; these pontoons had two winches on deck and were large enough to accommodate a gang of coolies. Attached to one of the anchors on each pontoon was a 5-in. manila rope, which was paid out along with the anchor chain and fixed temporarily to the bollard on the pontoon. The mattress was pulled in between the four pontoons through the mooring loops, and secured with hard wood toggle pins, the ends of the mooring ropes being fixed to bollards on the pontoons. The mattresses could be moved in any direction by working on the pontoon anchors. During this operation, the long and short portions of the mooring ropes were adjusted by turning the toggle pins in the loops by hand. The short lengths of the mooring ropes thus moored the mattress in position, while the longer lengths served as guides while the mattress was sinking.

When the mattress was in position, four 75-ton stone barges were placed in pairs on each side of the mattress, with their anchors dropped well outside, and at slack water the mattress was tied in two places to each barge

FIG. 5. THE RECENTLY COMPLETED MASONRY TRAINING

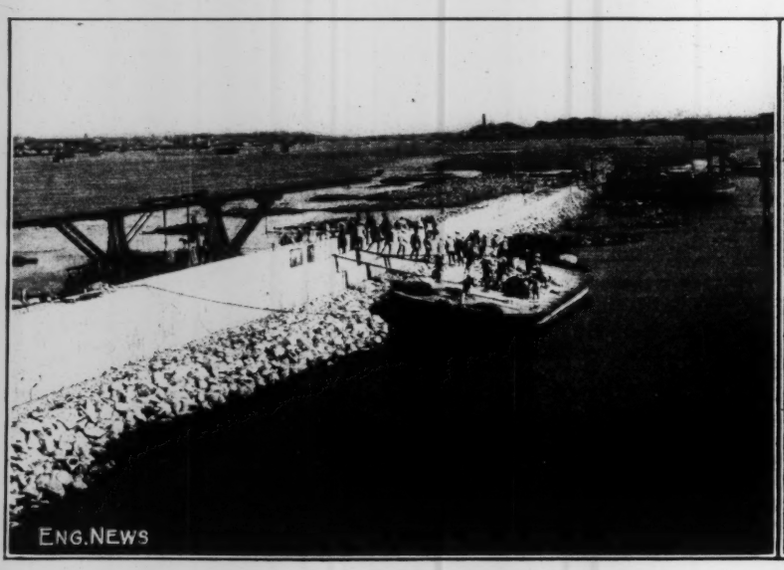
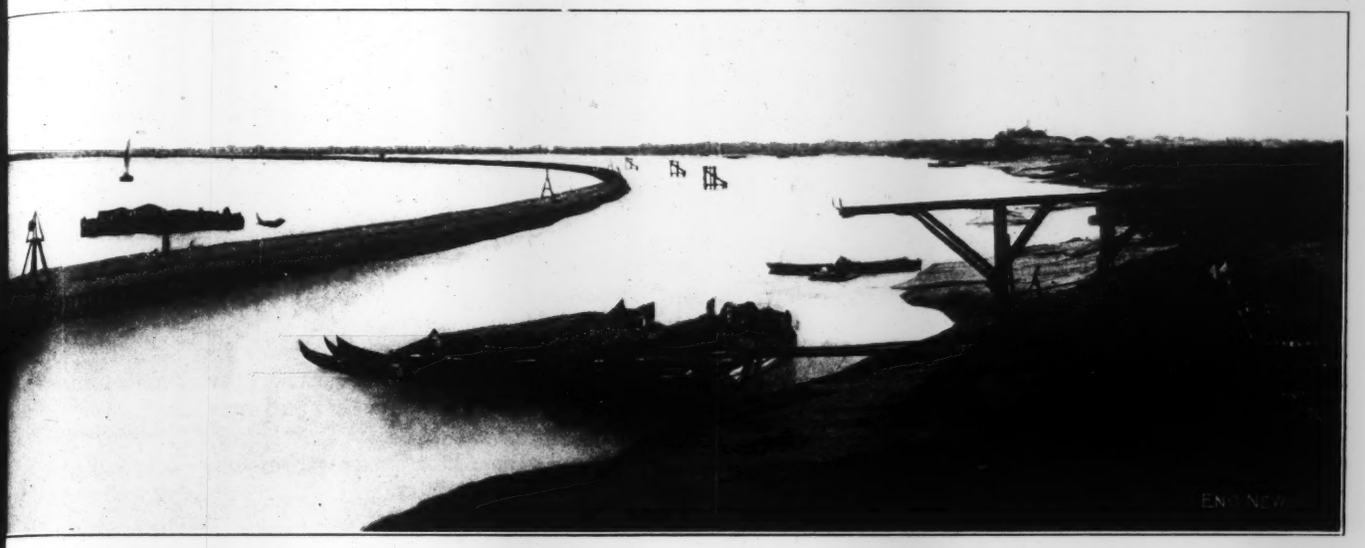


FIG. 6. THE TRAINING WALL UNDER CONSTRUCTION

FIG. 7. DISCHARGE END OF HYDRAULIC DREDGE LINE, SHOWING METAL PONTOONS

by ropes which had one end fixed to the bollard of the barge, the other end passing through the mattress and coming back to the bollard again. The mattresses were generally sunk at high water. As soon as the current became slack, stone was carried along planks and deposited on the mattress from the middle outward until the mattress was totally submerged (Fig. 4). At a given signal, the tie ropes were loosened from the stone barges and the mooring ropes paid out until the mattress sank.

At the same time, one pair of stone barges was pulled across the mattress and the coolies deposited stone as fast as possible. The average weight of stone required to sink a mattress was about 80 tons, but 300 tons was always deposited at the time of sinking, and the average time to sink a mattress and cover the 300 tons of stone was 20 minutes, working 120 to 150 men. The sinking of the mattress was hard and anxious work. They were unwieldly to tow, and if moved too soon before slack water were apt to take charge of the tug, and if moved too late after slack water they were liable to be caught by the ebb tide and overturned while sinking. The mattress work took from February, 1910, until July, 1911, which was nearly a year and a half less than the allotted period.



WALL IN THE RANGOON RIVER, AT RANGOON, BURMAH

INDICATING PIERS—To mark the line of the wall to assist in fixing the positions for the line of mattresses, the dumping of the stone from the hoppers, and surveying and sounding, timber piers were erected 500 ft. apart, along the back of the mattress course. In the first instance, the local timber was used, which had a reputation for resisting the ravages of the sea-boring insects,

FIG. 8. CASTING THE CONCRETE SLABS FOR THE UPPER PART OF WALL

but either the reputation rested on very feeble premises, or the sea worm in the Rangoon River was peculiarly voracious, for all the first set of piers, consisting of solid timbers 14 in. square, began to collapse about four months after being placed, the piles below low water being eaten clear through. They were rebuilt with the same timber, but the new piles were sheathed with zinc.

ROCK WORK—After the mattresses were sunk and covered as far as possible with the requisite thickness of stone, steam barges were employed in dumping rock steadily on the center line of the wall. When this rock was brought to water level, it was found that the waves breaking over it would cause too great roughness in the channel, so the additional 9 ft., as described before, was decided upon. For this work, 17,000 reinforced-concrete slabs were cast and placed in less than six months. Fig. 8 shows the coolies at work casting the slabs, and Fig. 9 the operation of filling them.

DREDGING—As soon as the wall was sufficiently advanced, a hydraulic dredge was set to work cutting a channel 1000 ft. wide outside the wall, and pumping the material behind the wall (Fig. 7), but after making

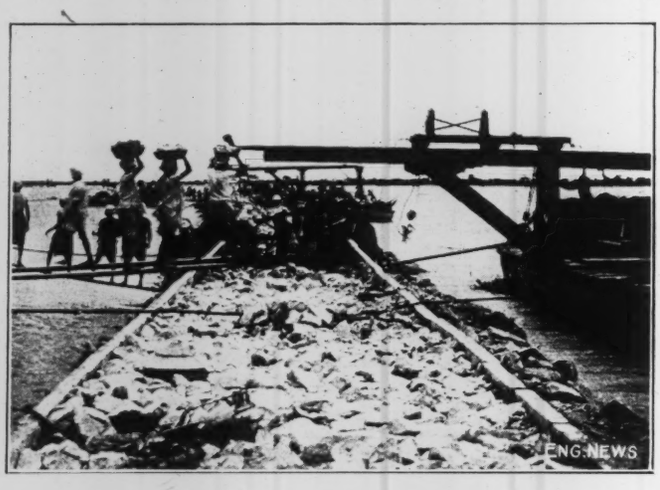


FIG. 9. PLACING STONE BETWEEN CONCRETE SLABS FOR UPPER PART OF WALL

several cuts it was found that the river was deepening from its own current, and the dredge was withdrawn. At present, all erosion on the right bank is stopped, the area between that bank and the wall is filling up naturally at the rate of 3 ft. per month, and a deep channel has been cut by the river between Rangoon and the wall.

COST—On an average, about 2500 men have been employed throughout the period of work. Actual construction began in February, 1910, and the estimated date for completion was December, 1915; the work was formally opened on Feb. 17, 1914, about 21 months before the estimated time.

PERSONNEL

The design and construction of the training wall have been from the beginning under charge of Geo. C. Buchanan, M. Inst. C. E., who is Chairman and Chief Engineer of the Port Commissioners of Rangoon. The executive engineers at various phases of the work have been L. W. Lewis, the late W. G. Keay, and E. C. Nivin. Messrs. P. W. & C. S. Meik, the late J. R. Bell, and E. L. Corthell have at various times acted as consulting engineers on the work.

New Specifications for Concrete Pavements, New York State Highway Commission

The specifications for cement-concrete pavements adopted by the New York State Highway Department on Jan. 15, 1914, are similar to those under which the much advertised Wayne County roads in Michigan were built, and provide for a richer mixture and more care in construction than the previous New York specifications. The standard specifications are to be modified to suit local conditions when necessary by special instructions printed upon the plans, which are made a part of the specifications. Thus no standard thickness of either course is specified, but is to depend upon the cross-section selected for the particular locality.

The new specifications will make the roads considerably more expensive than the concrete pavements hitherto built in New York,* but it is expected they will be much more durable.

A great saving of time and money has been effected by the method the New York State Highway Department has adopted of printing a standard specification covering all types of road, the proposal and contract agreement (a 68-page booklet), and furnishing it to the contractor with separate standard blank bidding sheets, containing 72 printed items, covering every phase of road construction and maintenance, with 8 blanks for any special items. A sample form containing the first three items is shown herewith.

Item No.	Approximate quantities	Items with written unit bid price	Unit bid price Dolls	Unit bid price Cts.	Amount bid Dolls	Amount bid Cts.
1	.....	Lump sum clearing and grubbing, For ..... Per lump sum	.....		.....	
2	.....	Cu.yd. earth excavation, For ..... Per cu.yd.	.....		.....	
3	.....	Cu.yd. rock excavation, For ..... Per cu.yd.	.....		.....	

In submitting his bid by filling in the blanks with the proposed prices the contractor agrees to accept the unit bid prices in compensation for any additions or deductions caused by variations in the approximate quantities due either to more accurate measurements, or to changes or alterations in the plans or specifications. This clause in the contract is designed to avoid the "special work" feature which has proved so profitable to dishonest road contractors and politicians on the work now being investigated in New York State.

The specifications for cement-concrete pavement and the accompanying plan are given below:

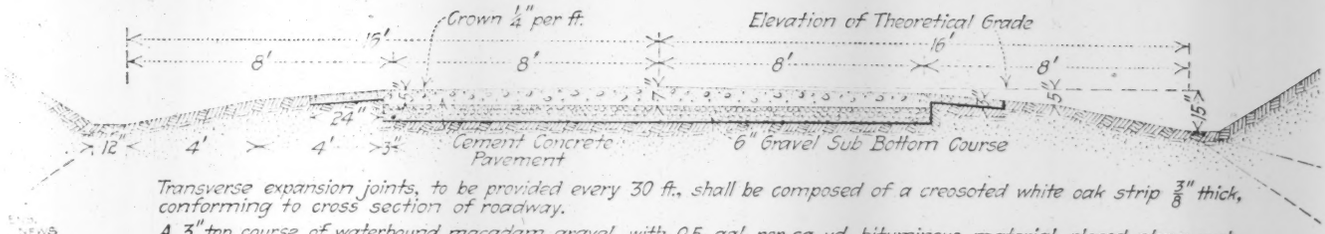
(1) The contractor shall furnish and place upon a properly prepared subgrade or sub-bottom course, concrete pavement of the thickness shown upon the plans or ordered by the engineer.

(2) Concrete pavement will be placed on the subgrade or on the sub-bottom course, and shall not be placed until these are in first-class condition, as required for macadam pavement.

(3) Concrete shall consist of a mixture of portland cement, sand or screenings, and broken stone or gravel. All these materials shall pass the tests required and all the specifications relating to first-class concrete shall apply to work done under this item, insofar as same are not inconsistent with the special specifications given below.

(4) The concrete shall be mixed in the proportions of one volume of cement to four and one-half volumes of sand or screenings and broken stone or gravel. The volumes of sand or screenings and gravel or broken stone, shall be measured separately in approved hoppers. The relative proportions of fine and coarse aggregate will be varied slightly,

*See article in "Engineering News," Dec. 4, 1913, p. 1148, by W. G. Harger on "Types of New York State Roads."



Transverse expansion joints, to be provided every 30 ft., shall be composed of a creosoted white oak strip 3/8" thick, conforming to cross section of roadway.

A 3" top course of waterbound macadam gravel, with 0.5 gal. per sq. yd. bituminous material, placed along each side as shown.

CROSS-SECTION OF TYPICAL CONCRETE ROAD, NEW YORK STATE

as a result of tests for voids by the engineer, to the end that resulting concrete shall be as dense as possible. The concrete shall in all cases approximate a 1:1½:3 mix.

(5) The coarse aggregate shall consist of a well mixed product of No. 2 and No. 3 stone or No. 1 and No. 2 gravel. The fine aggregate shall consist of the same material and sizes as specified for fine aggregate for first-class concrete.

(6) The concrete shall be mixed in approved mechanical batch mixers. Mixing shall be continued until every particle is coated with mortar and until the batch is of uniform color and consistency. After the materials are once wetted the work shall proceed rapidly until the concrete is in place. The quantity of water used shall be as directed by the engineer and suitable measuring tanks shall be provided by the contractor so that the same amount of water may be used in the separate batches.

(7) Substantial forms shall be placed along the edge of the concrete pavement and shall be set and held true to line and grade.

(8) Before any concrete is placed, the subgrade shall be sprinkled sufficiently to dampen it, but a muddy condition shall not be allowed. As soon as possible after mixing, the concrete shall be deposited in place and thoroughly rammed so as to bring the mortar flush to the surface. Especial care shall be taken to keep the concrete uniform and to prevent pockets of stone or mortar.

(9) Heavy screeds cut to the lines required for the finished surface and resting upon the side forms shall be used for consolidating and screeding the concrete, and the surface, when completed, shall conform to the lines and grades shown upon the plans, and shall be free from depressions or irregularities. No stone shall project above the general surface. All shaping and screeding shall be done before the concrete has taken its initial set. Any concrete which has not been shaped and finished previous to the time of initial set, shall be removed for the full depth of the roadway and replaced with satisfactory concrete.

(10) If a satisfactory finish cannot be obtained with the screed, the screeding shall be immediately followed, and before the cement has taken its initial set, by rubbing down with a wooden float. The men employed for this work shall be competent and experienced and shall work from a platform which rests on the forms or shoulders. The surface, when finished, shall be such that no water will stand on the finished pavement. It shall then be slightly roughened by brooming.

(11) As soon as the concrete has taken its initial set the surface shall be covered with a 1-in. layer of sand or other suitable material of which the shoulders are to be constructed and this shall be thoroughly sprinkled every morning and night, and more often if necessary, so that it will be kept moist for a period of ten days after placing; the material shall then be cleaned from the surface and the road may be opened to traffic if so directed by the engineer.

(12) The concrete shall be deposited in sections 30 ft. in length, and at the end of each section expansion joints of the type shown on the plans shall be placed. After starting any section, an effort shall be made to complete it at one operation. If for any reason this cannot be done, a vertical joint shall be made when the work is stopped and the work completed up to this joint.

(13) Any cracks, either longitudinal or transverse, which develop before the acceptance of the work, shall be thoroughly cleaned out and filled with acceptable bituminous material.

(14) The quantity to be paid for under this item shall be the number of cubic yards of concrete pavement incorporated in the work, in accordance with the plans or as directed by the engineer.

The price bid shall include the furnishing and placing of all materials; all mixing, screeding, finishing, forms, expansion joints and all labor, appliances and incidental expenses necessary to complete the work. The amount to be estimated shall be computed by multiplying the cross-section of concrete pavement as shown upon the plans or ordered by the engineer by the total length of pavement measured along the axis of the road.

Protection of New Pavements against Destruction by Trenching, Macon, Ga.

It is not uncommon for cities to guard against disturbance of new pavements by requiring that new street pipes shall be laid and changes in old pipe made before the pavement is put down and that for a time thereafter the pavement shall not be disturbed. An ordinance to the same end, which is perhaps more drastic than the usual run of such regulations, was passed by the city council of Macon, Ga., on Apr. 7, 1914. The substance of it is as follows:

Sec. 1. Be it ordained * * * that * * * prior to the paving of any street or alley in the City of Macon, 30 days' notice shall be given by publication to the Water Commissioners, plumbers and the public generally of the designation of said street or alley for paving, and the date of beginning of same, so that all excavation can be made and pipes laid or lowered before the actual work of said paving begins.

Sec. 2. For a period of five years from the beginning of said paving, it shall be unlawful for any person, firm, company or corporation to make excavation into, or in any way disturb, the surface of said paving.

Sec. 3. On the designation of a street or alley to be paved, it shall be the duty of the City Engineer to inspect all water, gas and sewer connecting pipes existing in said street or alley for the purpose of ascertaining their condition, and wherever the condition of said pipes is found to be such as to require repairing or replacing within the said five years, he shall give notice for such condemned pipes to be repaired or replaced at once. Whereupon, the person, firm, company, or corporation so notified shall comply therewith.

Sec. 4. On the designation of a street or alley to be paved, the Chief of Police, or other officers of the police force detailed by him, shall notify the owners, or their agents, of the property abutting on each side of said street to proceed to lay lateral sanitary sewer connections from the trunk line of sanitary sewers along said street, to the curb line. He shall further notify all gas, water, telephone, electric light, or other companies, and the Board of Water Commissioners, having lines of pipe, wire, etc., underground, to proceed to lay lateral lines from their trunk lines along said street to the curb lines. All such lateral lines of sewers, water pipes and gas pipes shall be laid at intervals of every 50 ft. in the residential part of the city, and every 20 ft. in the business section of the city, as may be designated by the City Engineer, and all such persons, firms and corporations so served shall, within ten days from the date of such service, begin work on said lines in compliance with this ordinance and finish the same promptly and with all reasonable dispatch.

Sec. 5. For a violation of this ordinance the offender shall be summoned before the Recorder, and punished as prescribed in the Act creating the said Recorder's Court.

It would be interesting to know how many cities having ordinances of this kind rigidly enforce them, both as pipe work before and trenching after a new pavement is laid.

Anchor-Bolt Tension: Six Different Results from Six Books

By R. Fleming*

With Editorial Discussion

The writer a few weeks ago had occasion to review the design of a self-sustaining steel chimney, held down by six anchor bolts. From six different books he obtained six different solutions for the pull on the anchor bolts. It may be of interest to pass on to your readers these solutions. Note in the specific case given the varying results, from 26,500 lb. to 57,100 lb. The writer will make no comments. He hesitates to take up a seventh book.

1. Johnson, Bryan and Turneaure in their "Modern Framed Structures," eighth edition, 1904, chapter "Stand Pipes and Elevated Tanks," give a solution as follows:

The stresses in the anchor bolts may be calculated on the assumption that the tank is a cantilever beam in which bolts are made to replace the solid shell at the bottom. The bending moment is the overturning moment of the wind, and the moment of resistance is the moment of the stresses in the bolts about the neutral axis. In the sketch herewith, let A, B, C, D, E, F represent the anchor bolts, r the radius of the chimney and R the radius of the bolt circle. The rest of the notation explains itself. Assume first that the wind is in the direction OH. The line AD is the neutral axis and the moment of resistance is equal to the moment of the tensile stresses at B and C plus that of the compressive stresses at E and F taken about axis AD. Let M = overturning moment due to wind. P = pull on rod B or C, equal to the compression at E and F. Then $M = 4\ PG$ or

$$P = \frac{M}{4\ G}$$

Now suppose the wind in the direction OE. The neutral axis will be the diametral line ff perpendicular to OE. The distances of the bolts C and B from this line will be respectively g and $2\ g$, and the stresses in these rods will be proportional to these distances. Hence, if P_1 is the pull at B, that at C and A will be $\frac{P_1}{2}$. Likewise for the compressions at E, D and F. Equating moments about the neutral axis, we then have $M = 2 \times (P_1 \times 2\ g) + 4 \times \left(\frac{P_1}{2} \times g\right)$ or $P_1 = \frac{M}{6\ g}$. Now $g = \frac{R}{2}$ and $G = \sqrt{\frac{3}{2}}\ R$ or $g = 0.58\ G$ and

$$P_1 = \frac{M}{3.48\ G}$$

It will be seen that the value of P_1 is greater than P and must be used for the maximum pull on anchor bolts.

2. The first edition, 1893, of "Modern Framed Structures," takes into account the weight of the tank in determining the net overturning moment. Assume the wind in the direction OH. Let M_w = moment of resistance of dead weight, = $W \times$ distance $OH = WG$. Let M = overturning moment due to wind, and P = pull on rods B and C. The moment arm is taken as CE. The middle bolts A and D are stated to have no stress. Then $M = WG + 4\ PG$ or

$$P = \frac{M - WG}{4\ G}$$

For wind in the direction OE, however, the method followed is the same as for the corresponding case in Method (1), except that the moment of resistance due to weight of stack, taken about the tangent to the bolt circle, is deducted. This gives

$$P_1 = \frac{M - 1.16\ WG}{3.48\ G}$$

The relative values of M and WG will determine whether P or P_1 is the greater.

3. In the seventh edition of "Modern Framed Structures," with the wind in the direction OH, the anchor bolts A and D are assumed to take a pull equal to one-half the pull on B and C. With the same notation as before, $M = WG + 4\ PG + PG$ or

$$P = \frac{M - WG}{5\ G}$$

For wind in the direction OE, however, the fulcrum is taken at the center line, just as for the corresponding case in the previous paragraphs, and the resulting formula, as in Method (2), is

$$P_1 = \frac{M - 1.16\ WG}{3.48\ G}$$

4. The chapter on Steel Chimneys in Christie's "Chimney Design," second edition, gives a method for proportioning anchor bolts. The net overturning moment from the wind and the resistance due to the weight are first found: $T = M - m$.

This is the moment on the foundation bolts, which are equally spaced in a circle, and are from 6 to 12 or even more in number, and the calculations for the bolts are made as follows:

Considering any point in the bolt circle, the approximate mean distance from the circumference of same on a line through the center of the bolt circle to all of the bolts is the radius of that circle; and considering that one-half of the bolts only stand the strain, we have this equation, $Tc = \frac{De}{2} \times$ tension on bolts; where De = diameter of bolt circle, $Tc = \left(T \times \frac{De}{2}\right) \div \frac{Db}{2}$, or the moment on the foundation bolts.

Db is the diameter of the lower ring of the chimney $= r$ in figure above. The value of Tc divided by one-half of the product of r times the number of bolts gives the maximum pull on any bolt. It is necessary to follow the calculations of the chimney given in his book to get the author's meaning.

5. In Hess' "Graphics and Structural Design" is a chapter on "Chimneys." In calculating the foundation bolts for a self-sustaining steel chimney the chimney (under wind toward the left) is assumed to overturn about the axis cc. The maximum fiber stress, or fm, will occur in bolts E and F. The fiber stress in any other bolt will be fm multiplied by the ratio of its distance from cc to the distance of the bolts farthest from cc; thus the fiber stress in the bolts A and D is $fm \times \frac{R}{R + G}$. The pull in any bolt will be the area of that bolt times the fiber stress. Taking the case of six equal bolts, as shown, we have

*30 Church St., New York City.

Bolts	Distance	Pull	Moment
B and C	R(1—cos 30°) = 0.134R	$P \times \frac{0.134R}{1.866R}$	$2 \times P \times R \frac{0.134^2}{1.866}$
A and D	R(1—cos 90°) = R	$P \times \frac{R}{1.866R}$	$2 \times P \times R \frac{1}{1.866}$
E and F	R(1—cos 150°) = 1.866R	$P \times 1$	$2 \times P \times R \times 1.866$

This gives a total moment of 4.8 PR. The tipping moment is taken as the moment due to the wind, less the moment of resistance due to weight of stack, or $M - WR$. Then the pull on bolts E and F is found to be

$$P = \frac{M - WR}{4.8\ R}$$

If the author had considered the moment about an axis dd, tangent to the bolt circle at one of the bolts, he would have found a maximum pull

$$P_1 = \frac{M - WR}{4.5\ R}$$

6. Hazlehurst, in "Towers and Tanks," third edition, 1910, in calculating the anchorage for a standpipe, first

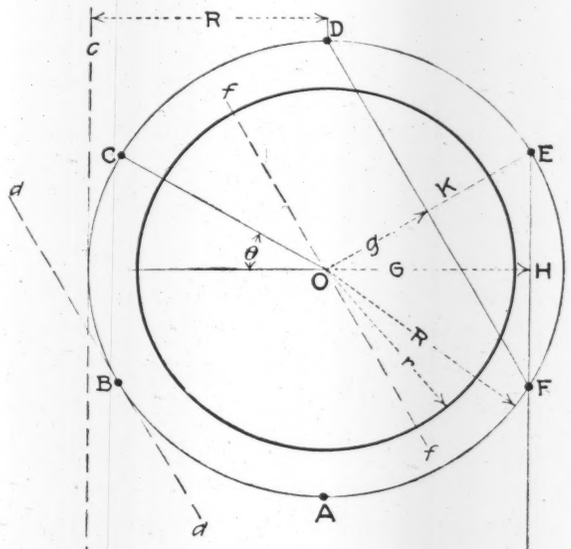


Diagram of Stack Base with Six Anchor Bolts

finds the moment due to the wind alone. He then finds the area of tank cross-section.*

The maximum stress per circumferential inch is the bending moment divided by the area; this value when multiplied by the length of the arc between anchor rods gives the maximum wind-stress on each rod. The net stress is found by dividing the weight of metal by the number of rods and subtracting from the maximum stress.

Assuming a steel chimney 6 ft. diameter throughout, 120 ft. high, weight of steel 30,000 lb., wind pressure 10,000 lb. on the diametral area, held down by six bolts equally spaced on a bolt circle 7 ft. in diameter, we have the maximum pull on each of the bolts in accordance with the above methods of calculation as follows:

1. 57,100 lb.
2. P_1 = 46,900 lb., P = 42,000 lb. In this case P_1 is to be followed.
3. P_1 = 46,900 lb., P = 33,700 lb. In this case P_1 is to be followed.
4. 28,300 lb.
5. 26,500 lb. (The more severe case by Professor Hess' method which he did not consider gives a pull of 28,300 lb.)
6. 52,100 lb.

The discrepancies between these results raise doubts as to the correctness of at least five of the sets of figures.

*Area πR^2. This is used not as area, but as section modulus of base-ring annulus, which, for ring-breadth unity, is equal to $\pi R^3/R = \pi R^2$.—Editor.

Editor's Discussion—The problem is not one of pure mathematics, but depends on the physical conditions of stack, base, and bolts. Unfortunately, in none of the six works cited is there any mention of these physical conditions. The formulas are given almost as rules of thumb.

The following discussion of the normal physical conditions may assist the reader.

The stack will be assumed to have a narrow ring-shaped base or footing, e.g., a steel angle, resting on the masonry foundation. Footing and foundation are in even contact. The nuts on the anchor bolts may be slack, in bearing, or screwed up under high initial stress.

First, suppose the nuts on the bolts are slack. The lower portion of the stack is sufficiently rigid so that it will not distort appreciably under the overturning tendency. When the wind moment exceeds the righting moment of the stack weight, the stack will lift at the windward edge. At and near the leeward edge a small segmental area of the footing will remain in contact with the masonry, carrying all the weight; its width depends on the amount of the elastic and inelastic compression at the contact face. The center of pressure on this area is the effective fulcrum of the tipping motion of the stack. The moment of the bolt tensions about this fulcrum, plus the moment of stack weight about the same fulcrum, must balance the wind moment. How many bolts are in action will depend on the condition of slackness of the nuts. With equal slack at all nuts, and rigid footing, only the two windward bolts will bear. The calculation, then, is identical with the first half of Method (2), estimating the center of pressure on the masonry to be near the line of the leeward pair of bolts.

Second, suppose the nuts just bear. The foundation is compressed by the weight of the stack, but on account of the large bearing area and the spreading out of the stresses as they go downward in the masonry, the indentation is very minute. As the wind moment exceeds the righting moment, the windward edge lifts off and the bearing concentrates near the leeward edge. It is reasonable to assume that, up to the point where the windward masonry compression becomes zero, the bolts take only a negligible amount of tension, as their stretch (equal to the prior masonry-indentation) is very small. As the deflection of the stack proceeds, the bolts are stressed in proportion to their distances from the neutral axis; the moment of each bolt equals its stress times its distance from the effective fulcrum. When the tipping moment greatly exceeds the righting moment of the stack weight, the compression is likely to be concentrated close to the leeward bolts. Thus, when the windward bolts are stressed to 12,000 lb. per sq.in., their stretch, for a bolt length of 5 ft. from nut down to anchorage, is about $^1/_{40}$ in., which on a diameter of 6 to 8 ft. means an angular motion large enough to leave only a narrow area in bearing at the leeward edge. The bolt stress, then, is to be computed by finding the moment of inertia of all the bolt areas about a fulcrum which may be taken at the leeward bolts, and dividing the net tip-

ping moment by the section modulus determined from this moment of inertia. This is as in the first half of Method (3), the second half being inconsistent, as already pointed out.

Third. Suppose the bolts are screwed up with a high initial tension. Theoretically, this tension may be made so great that the maximum tipping moment: (a) does not reduce the windward masonry compression to zero, and (b) does not reduce the leeward bolt tension to zero. With so large an initial stress, the stress actions are at all times symmetrical about the center line, and the case may be treated as a problem in bending. The stack weight has no righting moment. The above two governing conditions as to initial bolt tension mean that:

(a) The masonry "tension" or reduction of compression at the windward edge, under maximum wind, must not exceed the initial masonry compression. Letting

W = stack weight;
A = area of contact face of footing;
B = initial tension per bolt;
N = number of bolts;
c = initial masonry pressure, lb. per square inch.

Then

$$c = \frac{W + NB}{A}$$

and letting

M = maximum wind moment;
R = radius of footing;
I_m = moment of inertia of contact face of footing, about a diameter.
I_b = moment of inertia of the bolt sections, about a diameter of the base;
n = ratio of bolt stretch for 1 lb. per sq.in. tension, to masonry compression for 1 lb. per sq.in. loading;
d = edge stress on base ring due to wind;

then

$$d = \frac{MR}{I_m + I_b/n}$$

Therefore, as c must be at least as large as d,

$$\frac{W + NB}{A} = \frac{MR}{I_m + I_b/n}$$

But I_b is very small compared to I_m, and, since the masonry compression spreads out rapidly as it passes downward in the foundation, while at the same time the bolt length is large, the ratio n is likely to be large. Therefore, the right-hand side is only a little less than $\frac{MR}{I_m}$, which is nearly the same as $\frac{2M}{AR}$, as the area is annular, so that $I_m = \frac{1}{2} Ar^2$, where r is the mean radius. This shows that the initial bolt tension must be at least

$$B = \frac{2M}{RN} - \frac{W}{N}$$

Hazlehurst (Method 6) uses substantially this formula for the final bolt tension, in the form

$$B = \frac{M}{\pi r_s^2}\,\frac{2\pi r}{N} - \frac{W}{N}$$

but he calls πr_s^2 the area of stack cross-section, while it really means the section modulus of the footing ring, $\frac{\pi r^3}{R}$.

(b) The bolt "compression" at the leeward edge due to wind must not exceed the initial tension. The wind stress T in the windward and leeward bolts is

$$T = \frac{Mra}{nI_m + I_b}$$

where a is the area of section of one bolt. In this formula, for reasons above given, I_b may usually be neglected, or, approximately,

$$T = \frac{2Ma}{nAr}$$

This value is certain to be much smaller than the value for B deduced above from the masonry requirement, therefore the bolt requirement will not determine the initial bolt stress. Taking, therefore, the initial bolt stress as above found, and adding the wind stress, we get the total bolt tension as

$$B + T = \frac{2M}{RN} - \frac{W}{N} + \frac{2Ma}{nAR}$$

$$= \frac{2M}{RN}\left(1 + \frac{\Sigma a}{nA}\right) - \frac{W}{N}$$

To get an idea of the amount of the second term within the parenthesis, take a base 7 ft. in mean diameter, 4 in. wide, with six 2-in. bolts. For this, $\frac{\Sigma a}{A} = {}^1/_{56}$. If the compression in the masonry spreads out at 45° slope toward center and outside of base, to 6-ft. depth (anchorage depth), the compressive shortening for unit load is only about ${}^1/_{36}$ as great as the compressive shortening on a prism of constant cross-section. If the ratio Es/Em is 20, then the ratio n is ${}^{36}/_{20}$, or ${}^9/_5$, and

$$\frac{\Sigma a}{nA} = \frac{5}{9} \times \frac{1}{56} = 0.01$$

For these proportions, then, the bolt stress changes only 1% under wind, and the only quantity needed to reckon with is the initial bolt tension

$$\frac{2M}{RN} - \frac{W}{N}$$

given by Method (6).

Method (1) is identical with this except that the stack-weight per bolt is not deducted, hence the result comes out ${}^1/_6 \times 30{,}000 = 5000$ lb. too high (57,100).

The trouble with the figure 52,100 is that it does not represent a wind tension at all, but a tension to which an erector may screw up the bolt, unless he screws it up harder, or less hard.

Of course, the bolts may be initially screwed up to even higher stress, conceivably; but very high initial stresses in 2-in. bolts are quite unlikely. When the bolts are not screwed up to so high a tension, the wind stress will be relatively more considerable. Generally, for conditions intermediate between the "just bearing" and "high initial tension" conditions, the bolt tension will have an intermediate value.

As shown by Mr. Fleming's computations, the results for his specific example are:

Bolts slack, $P = 42{,}000$ lb.
Bolts just bearing, $P = 33{,}700$ lb.
Bolts under high initial stress, $P = 52{,}100$ lb.

the figures being subject to a slight increase when the direction of wind passes through two diametrally opposite bolts.

Kansas City Specifications for Sewer Pipe, and Experience in Testing Sewer Pipe

By Elwood S. Wallace*

Hundreds of miles of sewers have been laid, the pipe having passed an "observation inspection" and having been received on their size, shape and looks, which have failed, and not only have they been a source of trouble and expense, but because of their unsanitary condition have been a menace to health and comfort as well. There is but little difference between the looks of good and poor concrete or hard or underburned salt-glazed clay pipe, and the only reliable way to determine the quality of either is to test them.

About two years ago, Kansas City, Mo., adopted open specifications allowing the use of either clay or concrete pipe, placing the two materials in open competition. Contracts are awarded to the lowest bidders regardless

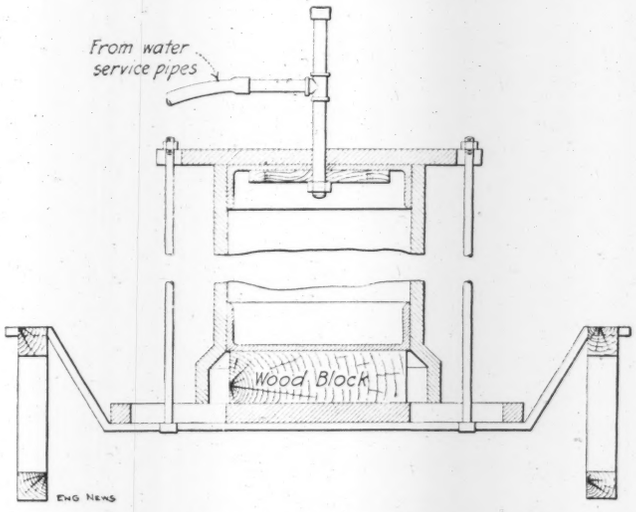


Fig. 1. Apparatus for Internal-Pressure Test of Sewer Pipe, Kansas City, Mo.

of the kind of material specified in the bid. The specifications required that certain tests should be made, but no apparatus for or method of making these tests had been devised except the "drop weight test," which has since been abandoned as being impractical, and of little value.

The hydrostatic apparatus was tried. At first a device was used which was furnished by the company manufacturing concrete pipe. It required, however, about a year to develop a satisfactory equipment, as described in Engineering News, Mar. 20, 1913. With some improvements the final apparatus there described is still in use. Fig. 1 is a sectional view of the hydrostatic test apparatus, showing the rubber cup gaskets in position for making a test.

The specifications for clay and concrete pipe are given as an appendix.

The total number of sewer-pipe tests made in 1913 was 1233; 22.45% of the concrete pipe and 11.66% of the clay pipe failed. As noted in the specifications the City Engineer or his representative selects a joint of pipe from each 200 lin.ft. delivered along the trench, which is as near as possible an average of the whole. All pipe thus selected have, obviously, already passed an "observation inspection"; had no tests been made, all the pipe would have been used in the work. The per cent. of failures shown does not represent the total amount of pipe rejected, for if the test-piece fails, a second one is selected from the same lot, and if this one fails the entire 200-ft. lot is rejected, and the contractor is required to remove the same from the work; otherwise the pipe is received.

The statement is often made that tests are of no value unless every pipe is tested. The time and expense required to test every pipe would be prohibitive, and our method of selecting test specimens is the one employed for other materials. In sampling a car of cement we select samples from about 20 sacks; from a car of paving brick we select 10 or 20 brick, which are taken as an average of the whole, and the acceptance or rejection of the car is based on the results obtained. While our methods do not absolutely insure that every pipe received will pass the tests, they have served to raise the standard; engineers, contractors, plumbers and others who are familiar with sewer work, are agreed in saying that Kansas City is now getting the best and most uniform quality of sewer pipe it has ever had.

We have practically abandoned the crushing test, as no pipe has yet failed on this test that withstood the hydrostatic test, while the reverse is not true; in fact, we have had no pipes that crushed below specified requirements. We have applied the crushing test to a pipe that had fractured longitudinally from end to end on one side, at 9 lb. internal pressure, embedded the cracked side in the sand, and found it to resist over 100% greater load than the specifications require. We have found that concrete pipe which percolated freely at a low pressure, and clay pipe which was soft and underburned, nevertheless resisted the required load by over 25%. Up to the present time, we have been unable to discover any ratio between the crushing test and the hydrostatic test. When proper care is exercised no low-grade pipe of either clay or concrete can pass the hydrostatic test. Improperly tamped or cured concrete or underburned clay pipe will fail, and the weak and defective places are disclosed. But little of value can be determined by the crushing test.

The high percentage of failures shown for the concrete pipe would be misleading without further explanation. Our tests have demonstrated that the curing of concrete is essential to the manufacture of good pipe. The curing sheds of the company manufacturing this concrete pipe were inadequate in capacity, and large quantities of pipe were stored in the open, exposed to the elements, before they were properly curd. As the summer was exceptionally dry and hot, the effects on unseasoned pipe were detrimental; the percentage of failures was much larger in summer than in the early spring or late fall, when the weather was damp and cooler.

Finally, the general opinion is that the city is securing a much better grade of sewer pipe as a result of the hydrostatic tests than could be obtained by any other method known at this time.

Internal-pressure tests can be made on pipe in sizes of from 8 in. to 12 in. in about five minutes each. The cost of testing was about $0.44 per 100 lin.ft. of pipe laid.

The records of sewer-pipe tests is kept on 8½x14-in. loose-leaf filing sheets, ruled to take three records per page. The sheets are made in triplicate. One copy is placed in the City Engineer's office for public record, one

*Cement Inspector, Kansas City, Mo.

TABLE OF RESULTS OF SEWER-PIPE TESTS IN 1913, KANSAS CITY, MO.

(Tests made in city labor cry, Waterworks Bldg., 6th & Walnut Sts.)

Clay pipe made by Dickey Clay Pipe Mfg. Co.

Concrete pipe made by K. C. Concrete Pipe Co.

Pounds pressure per square inch

Size, in.	5 to 9		10 to 19		20 to 32		33		34 to 39		40 to 49		50 to 59		60 to 69		70 to 79		80 to 89		90 to 99		100 to 109		110 to 120		Total		Pass		Fail		% Fail	
	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.	Clay	Con.
6			3	5	7	21	162	93		3				3		18		1		5	2	13	3	3			177	179	167	153	10	26	5 65	14 52
10			3	4	11	18	162	76	2	1		2	1	1				3		6			2	2	1	2	185	111	167	89	18	22	9 73	19 82
12	1		1		6	6	13	24				1		1		1		1		1			1				95	35	78	30	17	5	15 90	21 60
18	1		1		6	4	13	46		5		1		1		1		1									106	82	85	55	15	27	12 00	32 90
21	2				6	15	45	30				1		1		1											53	33	46	31	7	2	13 21	41 51
24					4	10	36	30	1	2	1	4		3	1	1		1									46	34	38	41	8	4	17 38	24 07
27					3	1	20	13																			21	11	20	13	1		16 67	7 14
			1		1		20																				23		20		3		13 04	
	4	2	32	33	46	84	607	312	3	11	1	12	1	15	1	21		7		12	2	13	3	3		3	703	530	621	411	82	119	11 66	22 45

Remarks

All tests shown in columns 33 to 110-120 inch passed, and those shown to left of column 33 failed 0 48% of the clay pipe failed on percolation test, all of which withstood internal pressure test. 2 of these were 27-in. and had several holes through the body of the pipe about the size of an 8d nail.

About 3% of the concrete pipe showed percolation (most of them 8-in.) but so far as known all failed below 33 lb. internal pressure except four 8-in. pipe which fractured at 42, 60, 101 and 42 lb. internal pressure.

Clay pipe shown in columns 90-99, 100-109 and 110-120 and most of the concrete pipe shown in columns 90-99, and 100-109 received full pressure without fracturing.

Hydrant pressure was used for making these tests, which varied from 92 to 112 lb.

Compression tests were made at intervals but were practically abandoned, as no failures have as yet occurred under the specified compression load.

copy is filed in the office of the Engineer of Sewer Division, and one copy is retained in the City Chemist's office.

Appendix: Specifications for Sewer Pipe

VITRIFIED PIPE SEWERS

Where vitrified pipe is called for, all pipe and specials shall be of the best quality, salt glazed, vitrified clay sewer pipe of the hub-and-spigot pattern; the body shall have a thickness of not less than ½ the inside diameter of the pipe, except 8- and 10-in. pipe, which shall have a thickness of ⅝ in. and ⅞ in. respectively. Each hub shall be of sufficient diameter to receive to its full depth the spigot end of the next following pipe or special without any chipping whatever of either, and also leave a space of not less than ½ in. all around for the cement-mortar joint; it shall also have a depth from its face to the shoulder of the pipe on which it is molded of approximately 2 in. greater than the thickness of said pipe. All pipe and specials shall be sound and well burned, with a clear ring, well glazed and smooth on the inside and free from broken blisters, lumps or flakes which are thicker than ¼ the nominal thickness of the pipe and whose largest diameters are greater than ⅛ the inner diameter of said pipe; and pipe and specials having broken blisters, lumps and flakes of any size shall be rejected unless the pipe can be so laid as to bring all these defects in the top half of the sewer. No pipe having unbroken blisters more than ¼ in. high shall be used unless these blisters can be placed in the top of the sewer. Pipes or specials having fire checks or cracks of any kind extending through the thickness shall be rejected.

No pipe shall be used which, designed to be straight, varies from a straight line more than ⅛ in. per foot of length; nor shall there be a variation between any two diameters of a pipe greater than ¼ the nominal diameter.

No pipe shall be used which has a piece broken from the spigot end deeper than 1½ in. or longer at any point than ½ the diameter of the pipe; nor which has a piece broken from the bell end, if the fracture extends into the body of the pipe, or if its greatest length is greater than ½ the diameter of the pipe, or if any such fracture cannot be placed at the top of the sewer. Any pipe or special which betrays in any manner a want of thorough vitrification or fusion or the use of improper or insufficient materials or methods in its manufacture shall be rejected.

PLAIN CONCRETE PIPE SEWERS

These specifications apply to concrete pipe ranging in size from 6 in. to 24 in. internal diameter.

Manufacture. All pipe must be the product of approved factories, and the Board of Public Works reserves the right to reject the entire product of any pipe works whenever, in its opinion, the methods of manufacture are such as not to guarantee uniform results, or where the materials used are such as to produce an inferior pipe, as indicated by repeated failure to satisfy the tests under these specifications.

The pipe shall be machine made. The cement used must be of the best quality of portland cement, fulfilling all of the requirements heretofore mentioned in these specifications.

Pipe 12 in. in diameter and under shall be made of concrete composed of one part cement to two and one-half parts of clean Kaw River sand. Pipe of larger diameter than 12 in. may be made of a mixture of one part of cement to two and one-half parts of clean Kaw River sand, or a mixture composed of one part of cement, one part of clean Kaw River sand and two parts of hard stone.

If a mixture involving the use of stone is adopted, samples of the stone must be submitted to the City Engineer and approved by him before the manufacture of the pipe is started.

All materials used in the manufacture, the process of manufacture and the marking and dating of pipe shall be subject to inspection at the factory.

Methods of molding, trimming and seasoning pipe shall be left to the discretion of the manufacturer, but as furnished for the work it shall be without warps, cracks or imperfections, and must not be delivered within twenty days after its manufacture. All pipe shall have the factory and manufacturer's name clearly impressed on the outer surface as identification mark, and shall in like manner have the date of the molding of the pipe indicated.

No pipe shall be used which has a piece broken from the spigot end deeper than the depth of the bell or longer at any point than one-half the diameter of the pipe; nor which has a piece broken from the bell end if the fracture extends into the body of the pipe or is longer at any point than one-half the diameter of the pipe.

Dimensions. When sizes of pipes are given, they shall mean the interior diameter.

All pipes shall be of the following minimum thicknesses, and the diameters shall not vary more than 3 per cent. from those specified.

Diameter, inches	Wall thickness, inches	Diameter, inches	Wall thickness inches
6	¾	15	1½
8	⅞	18	1¾
10	1	21	2
12	1¼	24	2½

Pipes not intended for curves or bends shall be true and straight. Each straight pipe having a branch or connection molded thereon shall not be less than 2 ft. nor more than 3 ft. long; plain pipe shall be in length not shorter than 2 ft. nor longer than 3 ft.

The hubs of all cement pipe shall be of the self-centering type, and there shall be left an annular space to permit of the making of a layer of cement mortar at least ⅛ in. thick between the hub and spigot.

TESTS

The contractor shall deliver at point indicated by the City Engineer one length of pipe for each 200 lin.ft. of vitrified or plain concrete pipe to be laid under this contract. This pipe is for testing purposes and shall be selected by the engineer

...d marked by him on the line of the work for identification ...hen tests are made, and shall be delivered by the contractor ...thout special compensation for the same.

The tests to which the pipe may be subjected are as ...llows:

External Crushing Test: When supported upon a bed of ...oroughly compacted sand of such dimensions and in such ...anner that an even bearing is provided throughout the ...hole length, but without appreciable displacement of sand ...the sides, the various sizes of pipe shall withstand the ...llowing pressures applied at the crown uniformly along a ...ne 1 in. in width and extending the whole length of the ...pe, exclusive of the bell:

Diameter, inches	Lb. per lin. ft.	Diameter, inches	Lb. per lin. ft.
6	1000	15	1300
8	1000	18	1450
9	1050	21	1700
10	1100	24	2000
12	1150		

Hydrostatic Test: Untreated pipe shall show no percolation ...p to 10 lb. per square inch, and shall resist fracture at 33 ...lb. per square inch internal pressure.

Promotion Examination from Junior Engineer to Designer with the Public Service Commission, First District, New York

An examination was held by the New York State Civil Service Commission on Mar. 28, for promotion to designer, grade 9; being equivalent to a salary rate of $1801 to $2100 per year. The examination was open only to employees in the engineering departments of the Public Service Commission drawing between $1501 and $1800. Credit was given for the written examination which follows and also for experience and seniority in the service. The examination was divided into two parts, the total time allowed being eight hours.

Part I consisted of five questions, of which questions to a total weight of 60 were to be answered. Part II comprised twelve questions, of which any four could be selected. The latter part while seemingly permitting a large choice, was really made up of a series of groups relating to different parts of the work handled by different special squads. Hence a man engaged in sewer work, of necessity would probably choose questions relating to sewers, while another man engaged in subway work would be forced to choose those questions relating to his work.

1. (weight 40). The line of a double-track subway carried it under the front wall of a building. The subway is parallel to the street, and the inner face of its side wall is 4 ft. inside the building line. The front wall of the building is 40 ft. long and transmits a load of 70,000 lb. per lin.ft. to a continuous footing 10 ft. wide, 30 ft. below the surface. Subway grade is 22 ft. below street grade. (a) Show a method of supporting the building during the construction of the subway. (b) Design the subway structure at this point. Assume that the standard section is of reinforced concrete.

2. (weight 40). A double-track elevated railway, with base of rail 35 ft. above street grade, and posts set 40 ft. c. to c. longitudinally, has station platforms 100 ft. long and 15 ft. wide cantilevered out from each side of the elevated structure. Design the posts, girders and platform supports.

3. (weight 20). The two inside or express tracks of a four-track subway are to have a branch up a street making an intersection angle of 60° with the present line. Make a plan and profile of the junction, avoiding grade crossings. Both streets are 120 ft. wide and are level.

4. (weight 20). Outline a method for determining the capacity of the ventilating apparatus and the quantity of cooling water needed to cool the air of a quarter-mile stretch of subway (double track).

5. (weight 20). The invert of a circular brick sewer laid on a grade of 1 in 700, is 4 ft. below the bottom of a four-track subway structure which it meets at 90°. Design a sewer crossing that will have resistance to flow equal to that of a circular sewer section, keeping the invert at the same grade as before. It is assumed that the sewer change is worked out in conjunction with the subway design.

PART II

1. What street loads are responsible for the estimated vertical pressure on subway structures? Discuss the effect of the actual loading—as to amount, distribution and frequency—as compared with the quantities used in design.

2. What local indeterminate or secondary stresses may exist in the steel framing of a standard subway roof?

3. What are the merits of brick in asphalt mastic as compared with tarred felt, in waterproofing subways?

4. In underpinning a building alongside a subway excavation, what conditions call for the use of (a) continuous footings (b) concrete piers (c) piles?

5. Make a pencil sketch of the arrangement of pipes for the drainage of a drip pan under a ventilator grating. The grating is 200 ft. long by 4 ft. wide; width of sidewalk 20 ft. Give sizes of pipe. Where the main drain pipes for station toilets are below the level of the sewers, what provision is made for caring for the drainage? Describe in detail.

6. Give a brief description of a cooling plant for a subway station, using ground water from driven wells for cooling the air. What provision is made for controlling the starting and operation of subway fans (exhaust) in emergencies?

7. Describe briefly the various types of pumping apparatus adapted for use in a subway. How are they operated?

8. Write a brief specification for the installation of an electric pumping plant in a subway for track drainage work?

9. Make a pencil sketch of a lighting plan for one platform of a typical local subway station, 480 ft. long, indicating the general arrangements of lights and panel boards, using more than one system of lighting. Make a circuit sheet for a typical local station, 480 ft. long, indicating the general arrangement of lights, using more than one system of lighting.

10. Give a brief description of the systems of lighting in general use in a typical local elevated station, and describe the arrangement of the lights.

11. Make a pencil sketch of a high-tension switchboard for use in transformer closets in subway stations. Make a pencil sketch of an outlet box for station lighting, indicating the method of securing the conduits to the box.

12. Write a brief specification for the installation of an electric-conduit system in a subway station on the "lump-sum" plan of contracting.

The Status of the Electric-Railway Industry in the United States for 1912 has recently been reported by the U. S. Bureau of the Census. The figures include electric-light plants operated in connection with electric railways and not separable therefrom, but do not include figures for mixed steam and electric railroads, nor roads under construction during the year 1912 and not in operation.

	1912	Per cent. of increase: 1902-1912
Number of companies	1,260	27.7
Operating	975	19.3
Lessor	285	67.6
Miles of line	30,437.86	82.9
Miles of single track	41,064.82	81.9
Cars, number	94,016	40.8
Passenger	76,162	26.3
All other	17,854	174.9
Electric locomotives	277	
Persons employed	282,461	100.7
Salaried employees	23,271	226.5
Wage earners (average number)	259,190	93.9
Power:		
Horsepower, total	3,665,051	171.6
Steam and gas engines (including turbines)—		
Number	2,312	—1.7
Horsepower	3,193,744	145.7
Water wheels—		
Number	383	140.9
Horsepower	471,307	858.9
Kilowatt capacity of dynamos	2,508,066	179.2
Output of stations, kilowatt hours	6,052,699,008	167.6
Current purchased, kilowatt hours	2,967,318,781	
Passengers carried	12,135,341,716	107.9
Revenue	9,545,554,667	99.9
Transfer	2,423,918,024	128.1
Free	165,869,025	
Car mileage	1,921,620,074	67.9
Condensed income account of operating companies:		
Gross income	$585,930,517	133.9
Operating	567,511,704	129.2
Transportation	520,184,773	120.4
Nontransportation	47,326,931	309.5
From other sources	18,418,813	524.2
Operating expenses	332,896,356	133.9
Gross income less operating expenses	253,034,161	133.9
Net income	61,910,753	102.3
Dividends (operating companies)	51,650,117	225.2
Surplus	10,260,636	—30.3

The Lost River Multiple-Arch Curved Dam

By W. W. Patch*

SYNOPSIS—To reclaim farming land being submerged by the rising waters of Tule Lake, which has no visible outlet, a dam has been built to divert a part of the inflowing water. To save length of diversion channel the dam was placed on indurated volcanic diatomaceous ash instead of on rock. An overflow capable of passing heavy floods being necessary, and this requiring protection against scour below the overflow, a horseshoe-shaped multiple-arch concrete spillway, 289 ft. in length, was adopted, with a low wall or secondary dam thrown between the toes of the horseshoe. The pool so formed was floored with reinforced concrete, covered with plank secured by concrete "toe-holds." The masonry spillway is flanked by paved embankments, held in place at their spillway ends by reinforced-concrete retaining walls, 31 ft. high.

One of the interesting features of the Klamath irrigation project of the United States Reclamation Service is Tule Lake, a large body of water lying partly in Oregon and partly in California, and with its surface about 4050 ft. above sea level. This lake has a surface area of about 96,000 acres, and a tributary drainage area of 2000 sq.mi., but it has no known outlet. During the last sixty years the lake surface has risen more than 18 ft., and thereby has covered 35,000 acres of good agricultural land, which it is now proposed to lay bare by the combined effect of evaporation and the diversion of a considerable proportion of the surface water flowing into it. Fortunately, there is only one influent stream of any importance, and this one, Lost River, drains 90% of the tributary area.

The discharge of Lost River has varied from a minimum of less than 100 sec.-ft. to a maximum of over 10,000 sec.-ft., while the annual yield for the five-year period ending with 1909 averaged 317,000 acre-feet.

In 1909, Clear Lake Dam was built, intercepting the flow from 600 sq.mi. of the upper portion of the Lost River drainage area, and storing it in a reservoir covering 25,000 acres. This will result in reducing the yield by more than 50,000 acre-ft. per annum, due to the greater evaporation from the water surface of the reservoir than from the marshes and small lake formerly covering a part of the reservoir site.

In 1911, Lost River Dam was built at a point ten miles

*Consulting Engineer, Klamath Falls, Ore.

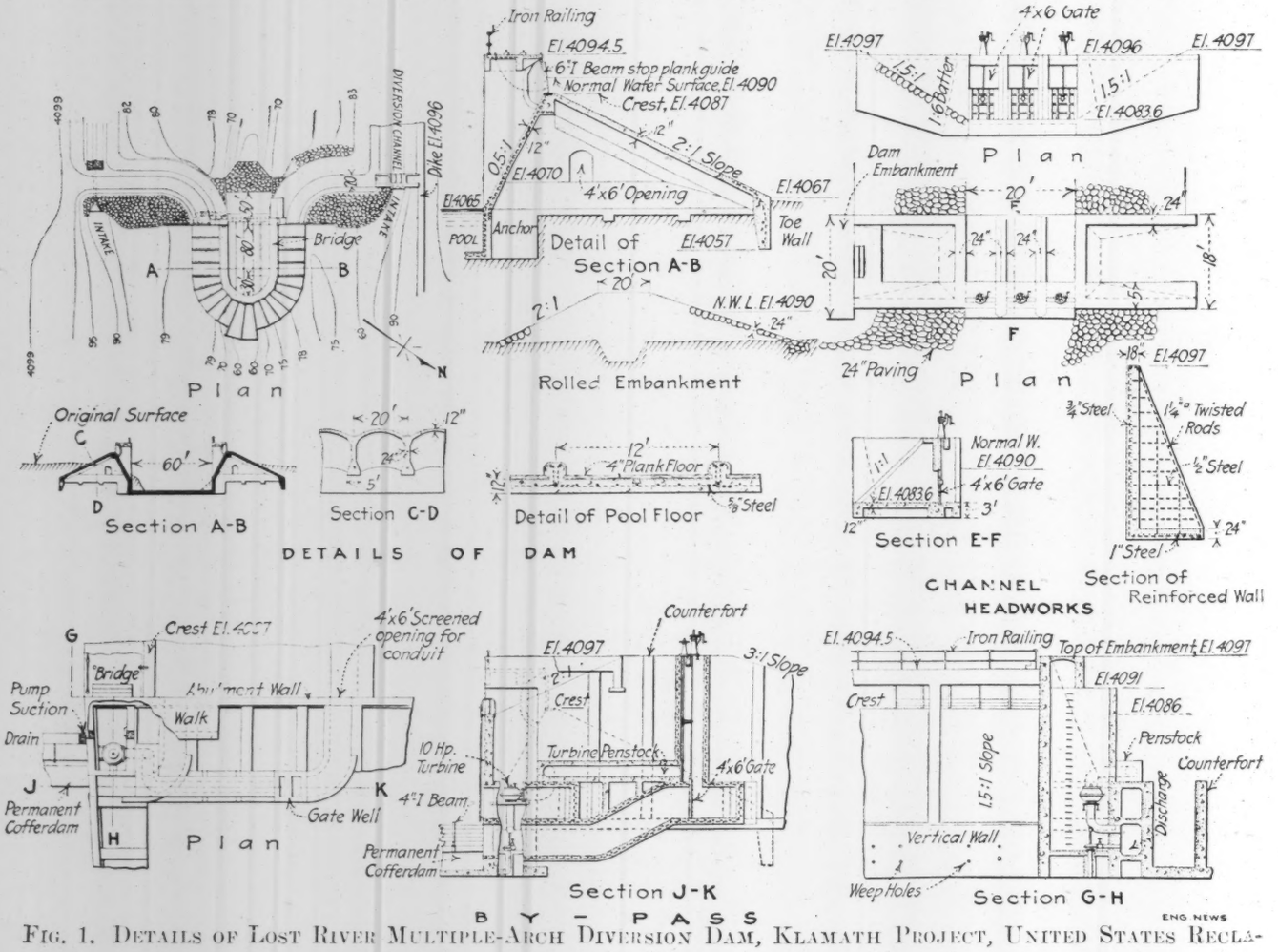


Fig. 1. Details of Lost River Multiple-Arch Diversion Dam, Klamath Project, United States Reclamation Service

above the mouth of the river, where it is possible by raising the river level 25 ft. to divert water from Tule Lake through a canal of 400 sec.-ft. capacity and eight miles in length into the Klamath River and thence to the Pacific Ocean. This diversion in an ordinary year amounts to over 100,000 acre-ft., and, combined with the effect of Clear Lake, will reduce the average annual discharge into Tule Lake by about one-half, and will lower its surface at the rate of about 1.5 ft. per annum for the next ten or twelve years, due to the excess of evaporation over the inflow.

Conditions Governing Design of Dam

The elevation of the reservoir flow line at the Lost River Dam was fixed within very narrow limits by the fact that the outlet to the diversion channel was established by natural conditions at Elev. 4086 ft., and owing to the flatness of Lost River Valley much valuable farming land would have been flooded or damaged if the water were raised above Elev. 4090 in the river channel. The shortest possible length for the diversion channel would be about eight miles, while to build the diversion dam upon solid-rock foundation would have made the channel twelve miles in length, with the same total available fall in each case. The normal discharge of the diversion channel would be 100 sec.-ft., with a maximum of about 400; hence with the low velocities due to the slight gradient there was a very strong argument in favor of the shorter channel and higher dam, notwithstanding the very unusual nature of the dam foundation in the latter case.

At the site selected, and for several miles both upstream and downstream, the river had cut through 8 or 10 ft. of surface soil and had eroded a channel in an indurated diatomaceous volcanic ash which underlies the surface soil over many square miles in this part of the country. This material generally can be plowed by a four-horse team and is excavated easily with a pick and shovel. When kept constantly wet it will retain a vertical face in excavation for years, and unless fissured it is remarkably water-tight under pressures up to 40 ft. of water. It resists erosion under moderate velocities, but when dried out slowly scales and crumbles. It is quite brittle, plowing out in large blocks which will float in water when well dried. Numerous open test pits and borings at the dam site demonstrated that for at least 40 ft. below the foundation level the material was homogeneous and massive in character, and as the maximum unbalanced water pressure could never be over 34 ft., and then only for a very short period, it was believed that the underlying foundation would prove sufficiently water-tight. This belief has been fully justified by the results of two years' operation of the completed structure.

Of necessity, the dam had to be of the overflow type, and as the writer knew of no data giving the safe loads upon this type of foundation material, and as the dam would be subject to more or less vibration in time of floods, the working load for the piers supporting the plain concrete arches was limited to 3 tons per sq.ft. Two other limiting conditions required that the dam should pass a flood of 10,000 sec.-ft. without raising the back-water higher than Elev. 4092, and that a large stilling pool should be provided in order to prevent scour below the dam. Stop-plank supports which can be readily removed by one man in a few minutes, thus leaving the entire length of spillway free from obstruction, satisfy the first of these requirements, and a pool 60x120 ft., and from 9 to 15 ft. deep, according to the water stage, and floored and surrounded by concrete, fulfills the second.

Description of Structure

The structure, as shown by the details, Fig. 1, and the view of the completed dam, Fig. 8, comprises rock-paved earth embankments normal to and on each side of the stream, and abutting a spillway section formed of 21 plain concrete arches inclined on a 2 to 1 slope, so arranged as to provide a horseshoe-shaped pool in the bed of the stream to receive the discharge from a spillway crest 289 ft. in length. Four right cylindrical arches on each side abut the 80-ft. tangent portion of the pool, while the semicircular end is bounded by 13 conical arches whose maximum span at the bottom is in no case over 20 ft. All the arches are 12 in. thick at the crown and 22 in. at the haunches, regardless of the span; 12 in.

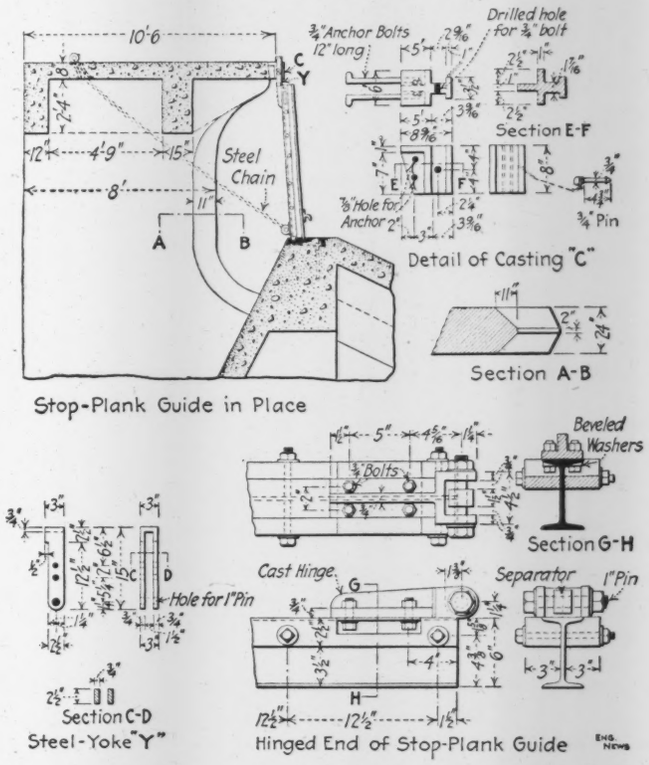


Fig. 2. Details of Stop-Plank Guide, Lost River Diversion Dam

having been selected as the minimum thickness needed to insure water-tight work without the necessity for plastering, or of requiring labor more skilled than the very indifferent quality obtainable in this section of the country. The loading of the arches can never be other than symmetrical, nor can they be subjected to impact; hence they were not reinforced, except that the bottom was tied in to the heavy curtain wall which extended as a cutoff about 10 ft. into the foundation material. This reinforcement has prevented any leakage due to deflection where the arch joins the cutoff wall.

The tops of the arches rest against a vertical parapet wall forming a heavy reinforced girder designed to resist the shocks of floating ice or drift, and supporting the stop-planks, as well as giving an anchorage for the flat reinforced face slabs connecting the piers. These slabs extend from pier to pier all around three sides of the

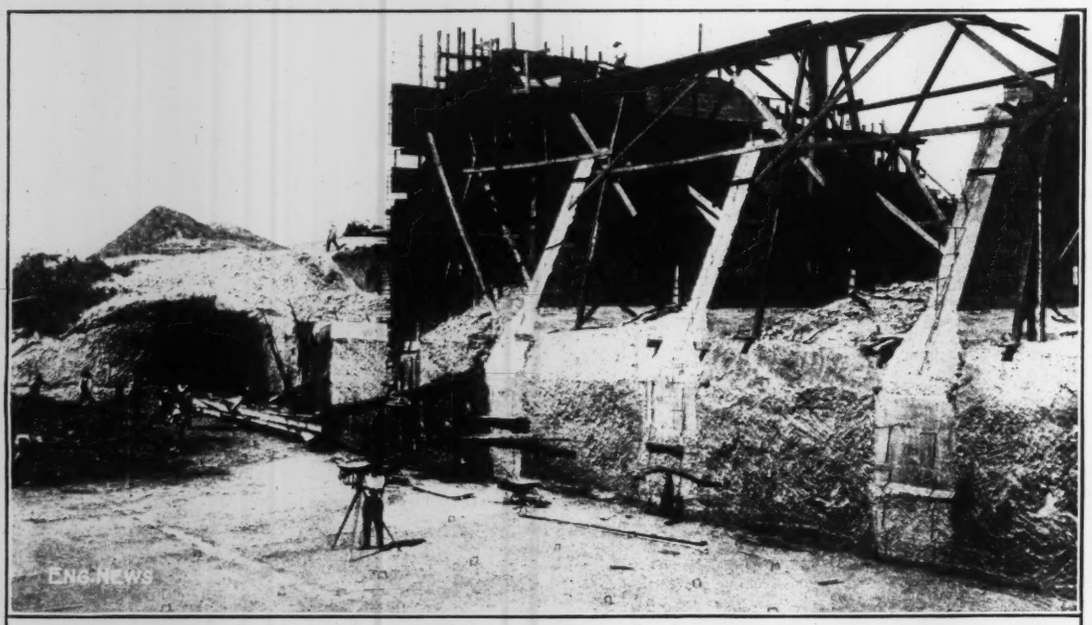


FIG. 3. EARTH FOUNDATIONS FOR POOL FLOOR

Natural earth trimmed to grade for floor and to line for rear of vertical slabs. Note how well the material stands in a vertical face 10 to 12 ft. high and how smoothly it can be trimmed to line. The inverted U's in the floor are to support the reinforcement and are driven into the ground about 6 in. The view shows some of the piers in the northerly row just before placing the reinforcement.

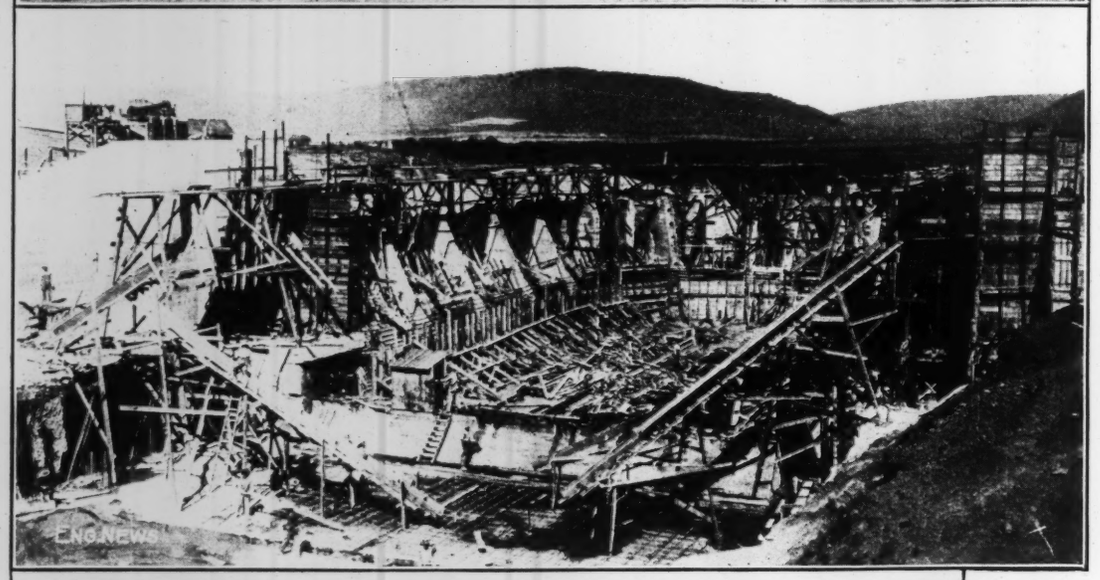


FIG. 4. DAM AND POOL FROM BELOW

Shows forms for vertical sides of pool and also permanent barrier below. The large amount of form lumber was due to delays caused by a strike, which threw the work behind until the season had so far advanced that concrete set very slowly and much of the form lumber could not be removed in time for repeated use.

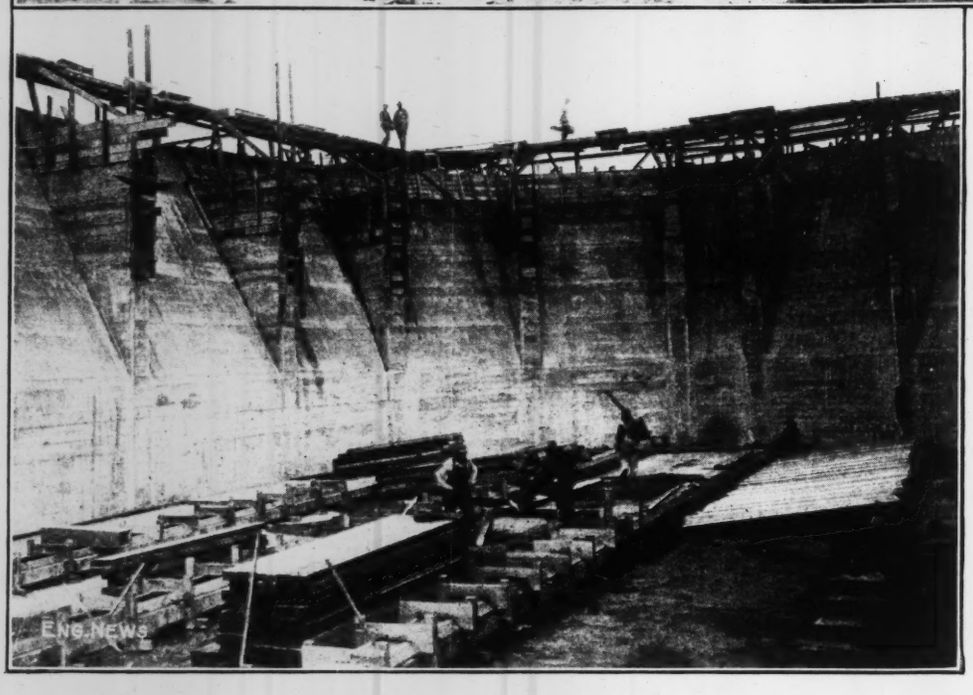


FIG. 5. NEAR VIEW OF DAM AND POOL FLOOR FROM BELOW

Placing the plank flooring under the concrete "toe-holds" of the pool floor. The planks were thoroughly water-soaked for a week, and were then slid into place diagonally on a bed of mortar, very lightly wedged at the ends, and thoroughly spiked at the center. The pool has been unwatered several times in the past two years, and the planks have been found in perfect condition.

MULTIPLE-ARCH CURVED CONCRETE STILLING POOL

FIG. 6. ARCH FORMS FOR UPPER SIDE OF DAM

Shows forms for both upper and under surfaces of arch. At the right may be seen the central top opening through which men tamped the haunches as the arch filling progressed. To prevent accident due to unbalanced thrust of the arches during construction 1-inch steel rods were used to connect each pier in the series from one abutment to the other.

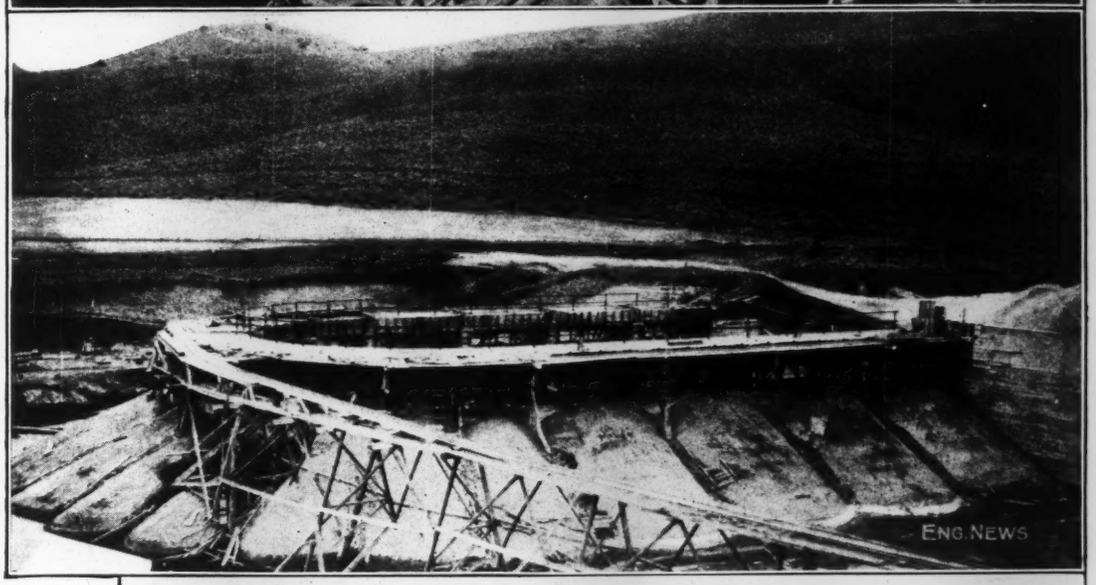


FIG. 7. SIDE VIEW FROM ABOVE

Arches completed, bridge on dam finished and guard rail partly placed.

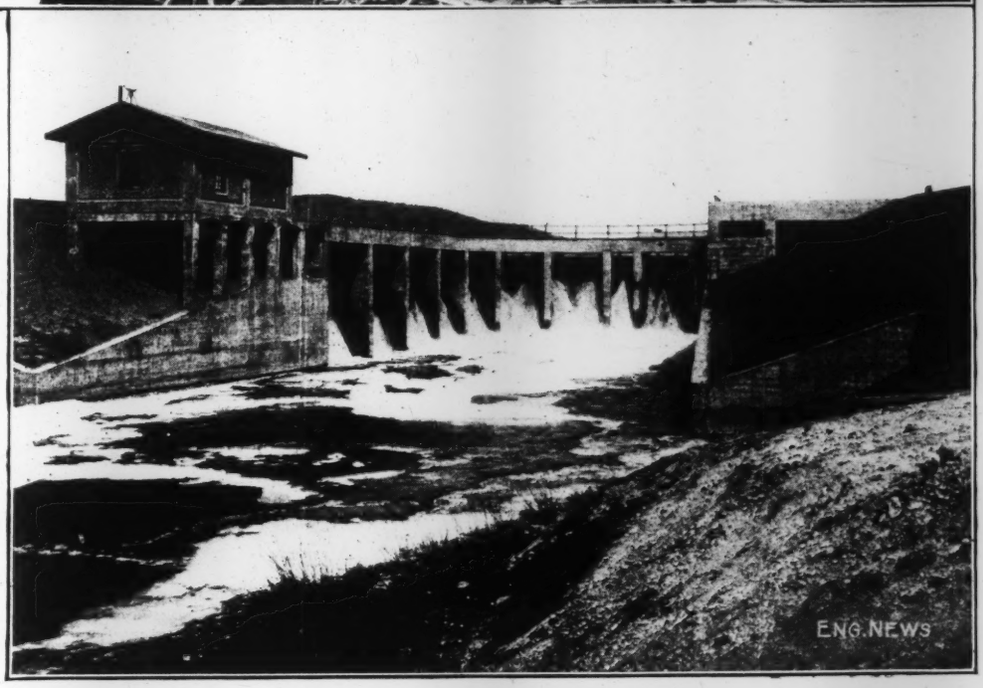


FIG. 8. THE COMPLETED DAM FROM BELOW

View taken after 15 months use, while passing the largest flood up to that time. The diverting channel was working at its maximum capacity of about 400 sec.-ft., and the balance of the flow, amounting to 1500 sec.-ft., was passing over the spillway. The disturbance in the upper end of the pool is considerable, but it will be noted that the water is passing quietly down the stream.

SPILLWAY AND HORSESHOE-SHAPED LOST RIVER DAM

pool, rising on a slope of ½ to 1 from Elev. 4065, which is the normal water level, to Elev. 4087, at the masonry crest carrying the stop-planks. This slab varies in thickness from 12 in. at the top to 18 in. at the bottom, and is reinforced to carry the full weight from the maximum discharge. Connecting the bottom of this slab with the pool floor is a vertical slab 18 in. thick, from 9 to 10 ft. high, reinforced on the outside to resist water pressure from the inside of the dam up to Elev. 4070, in case the water under the arches should not drain out through the weep-holes at the times when the pool is pumped out for inspection of the floor.

The piers, with a minimum thickness of 2 ft., are spaced 20 ft. c. to c., except around the semicircle, and have spread bases to reduce the pressure upon the foundation material. Each pier is pierced by a 4x6-ft. opening, connecting with a bridge for a footwalk extending under all the arches and being accessible by a suitable opening through the abutment walls in the southwesterly portion of the structure. This opening, in addition to four weep-holes in each of the vertical slabs between the piers, tends to keep equalized the water elevations in the pool and under the arches. There was no vital necessity for any reinforcement in the upper parts of the piers, but a very small amount was supplied to prevent possible displacement at poor horizontal joints during erection, and to make stronger resistance against vibration.

The pool flooring must be able to resist successfully the impact due to ice cakes 12 in. in thickness, which at rare intervals may be carried over the spillway during floods. At such times the water in the pool will be at least 15 ft. in depth. The floor was built of a continuous reinforced-concrete slab, 12 in. in thickness, and surfaced with a 4-in. wooden floor of red fir, which, if damaged, can be easily repaired. The plank being always submerged except at times of inspection will not be subject to decay. At the lower end of the pool a permanent concrete barrier 5 ft. high was built, on top of which collapsible steel I-beam frames carry 5 ft. of stop-planks. At the junction of the retaining walls at the southwest corner of the structure a concrete well was built in which was installed a 10-hp. Trump turbine direct-connected to an 8-in. vertical centrifugal pump. By this means it is possible to unwater the pool at any time by about five hours pumping, even although at low water the depth is about 9 ft. Each panel of the flooring is provided with two rows of 2-in. weep-holes spaced 6 ft. apart in each row and extending through both planks and concrete into the foundation material. These are designed to relieve upward pressure on the floor when the latter is unwatered, and their existence has already prevented serious damage to the structure, as will be noted later.

At the junction of the embankment with the spillway there are retaining-walls of reinforced concrete 31 ft. in height. Similar walls line the waterway for a distance of 70 ft. below the pool. Reinforced-concrete paving without the wood flooring is continued downstream from the permanent barrier for 40 ft., and is then succeeded by 30-in. stone paving laid on a rising grade for 50 ft. to join the old river bed. A reinforced-concrete bridge, 10½ ft. wide, is carried by extensions of the piers, and has its upper surface elevated 7½ ft. above the permanent crest of the spillway. The bridge forms a working platform from which the stop-planks are operated, and is furnished with a 3-ft. gage steel track and an eight-wheel truck for transporting planks to and from the concrete storehouse located at one end of the structure. The bridge piers are undercut and sharpened upstream so that they do not obstruct the upper portion of the nappe of the falling water.

Ease and certainty of control of the surface levels in the reservoir are of the first importance, for the diversion channel will not operate at full capacity unless the reservoir is kept above Elev. 4090, while if the water rises above Elev. 4092 damage to farming lands is imminent. For these reasons particular attention was given to the design of stop-plank guides which would permit of operating the planks individually, and at the same time would make it possible for one man to completely clear the entire length of the spillway in a case of urgency. Fig. 2 gives the details of the design adopted, which in two years of operation has been found entirely satisfactory, although the waterway has been completely cleared only for two or three adjacent panels of stop-planks for experimental purposes. The device consists essentially of four parts: a socket casting built into the concrete crest of the permanent spillway and containing a recess about 1 in. deep to receive the foot of the guide; a casting ("C," Fig. 2) built into the upper edge of the bridge over the socket casting, designed to receive the sliding yoke which is hinged to the guide and can raise the latter to clear the downstream edge of the socket; a steel yoke sliding in casting "C"; and a 6-in. steel I-beam with strips of oak bolted to it making stop-plank grooves about 3x3 in. in the clear. The guides are hinged at the top ends to the steel yokes before mentioned. The hinges and the yokes are kept oiled, so that in time of need one man with a bar can pry up the yokes sufficiently for the guides to clear the sockets, when the pressure of the water will swing the guides downstream and the planks will slip out. The attendant then draws the guide clear of the waterway by means of the chain and fastens the latter to the lower guard rail (not shown in the drawing). The 57 sets of stop-plank grooves and fittings cost about $900.

Details of Construction

The contract for building Lost River Dam was let to Geo. C. Clark, of Everett, Wash., in December, 1910. The United States furnished all the materials excepting lumber and part of the sand, delivering them to the contractor at Klamath Falls, Ore., 10 miles from the work. The roads were impassable for heavy hauling until the following April, and continued high water in Lost River prevented the excavation for foundations until about the end of April. As soon as the stage of the river permitted, excavations were made for the pier foundations on each side, and the piers on the northerly side were built. The foundations were excavated from 5 to 12 ft. into firm material, and they were almost perfectly dry, although the river had but recently passed over the ground surface, and was still flowing but a few feet distant at an elevation in some cases 10 ft. above the bottom of the foundation pits (see Fig. 3 to illustrate this point and Figs. 4 to 8, with subtitles, for other views and explanations of the construction work).

The contractor's plant was well adapted to the work, and it was well arranged, as indicated by Fig. 9. The contractor had no teams of his own, hence excavation was seriously delayed when hired farm teams were pulled off

to start harvesting. He was further handicapped by limited capital, and when an estimate payment was held up for several weeks the laborers struck for their wages and the organization was almost disrupted at the most critical time. These delays explain the extraordinary amount of form lumber, part of which is shown in Fig. 4, which is further explained in the subtitle to that illustration.

The proportions for the concrete used on the work were 1 cement, 2½ sand, and 5 broken basalt rock. The latter was screened into two sizes which afterwards were remixed in nearly equal proportions in order to minimize the percentage of voids. In pier foundations many large rocks were placed in the concrete to save cement. In joining new work to old a mortar coat was applied immediately ahead of the first batch of concrete, but after stripping forms, the exposed surfaces were neither plastered nor coated with cement wash. That the arches proved almost absolutely water-tight, even under the maximum head of over 30 ft., is due in no small measure to

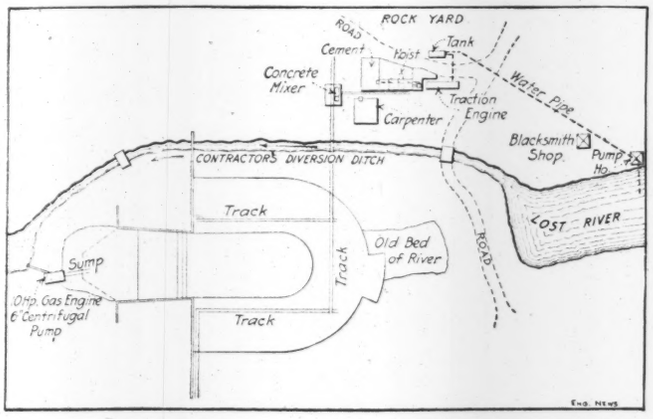


FIG. 9. ARRANGEMENT OF CONTRACTOR'S PLANT, LOST RIVER DAM

the unremitting care and skillful supervision of A. B. Cleaveland, assistant engineer in immediate charge for the United States.

The embankments were constructed in 4-in. layers, wetted and rolled. In excavating the cutoff trench beneath the south embankment an old refilled river channel was found which at its bottom, 20 ft. below the present surface, contained a number of Indian arrow and spear heads, mortars and pestles of excellent workmanship.

For making concrete of the character required on the dam, sand of proper quality could not be had in the vicinity. Hence, before the contract was let, arrangements were made to ship it in 75 miles by rail and then haul it 8 miles by canal, and 2 miles by wagon to the work. This sand on the job cost $3.75 per cu.yd. During the progress of the work the sand contractor could not supply his material fast enough, and the quality began to deteriorate, so that the United States shipped in quartz sand 300 miles by rail from Marysville, Calif., and delivered it on the siding to the contractor for 10c. per yd. less than he had been paying for the other sand.

COST OF WORK

The average force on the work comprised 82 men and 36 horses, working for most of the time ten hours per day. Wages were: foremen, $4.38; carpenters, $5; laborers, $2.50; two-horse teams, $6.25. The labor was not efficient as a rule. The accompanying table gives actual, not contract, cost, and includes cost of materials and engineering.

COST OF WORK ON LOST RIVER DAM

Item	Unit	Quantity	Total	Cost per unit
Exc. above Elev. 4067,	cu.yd.	9,073	$4,743	$0.522
Exc. below Elev. 4067,	cu.yd.	6,044	10,460	1.73
Embankment	cu.yd.	13,141	8,738	0.665
Rolling, sprinkling and overhaul			305	
Concrete	cu.yd.	5,536	84,510	15.258
Hndlg. reinf. steel	lb.	209,016	7,030	0.033*
Hndlg. structl. steel	lb.	48,254	557	0.012
Stone paving	cu.yd.	1,238	3,386	2.736
Pool flooring	ft.b.m.	25,588	846	33.07
Tool and plank house			2,145	
Five sluice gates and hoists			1,502	
Pump and turbine			1,118	
Stop-plank guides			847	
Stop-planks			330	
Hand rail			282	
Steel rails			342	
Tram car and miscell.			786	
Total cost			$127,927	

*Includes cost of steel.

The above includes reasonable allowance for depreciation of the contractor's equipment, which comprised the following:

1—70-hp. Minneapolis traction engine for operating the crushing, screening and mixing plant. This used 4-ft. slabs for fuel.
1—12x18-in. Aurora portable crusher, with bucket elevator.
1—rotating 29-ft. screen.
1—1-yd. Ransome concrete mixer.
1—7x10-in. double-drum hoisting engine for excavating with drag-bucket.
1—10-hp. gasoline engine with 6-in. centrifugal pump.
1—4-hp. gasoline engine with plunger pump connected.
1—band-saw for form work.
1—bucket elevator for sand hoist.
1—20-in. blower for removing surplus dust from crushed stone and stone dust so that the latter could be added to the sand.
6—9-cu.ft. steel concrete cars with about 600 ft. of 24-in. track.
1—driving team and buckboard.
Blacksmith shop, tools, iron pipe, etc.

All hauling was done with hired teams. In addition to running the plant the traction engine for the last two months of 1911 heated all the water used in making concrete to temperatures of 150° to 204°, and when doing this added duty was sometimes overtaxed.

INCIDENTS OF OPERATION

After the dam had been in use for about three months, and following a thaw subsequent to a week of very cold weather, water was discovered leaking over the top of the lowest corner of the southwesterly retaining-wall at a point about 60 ft. from the gate-well. The flow rapidly increased in volume until it reached about 1 sec.-ft. of very muddy water, when fortunately it suddenly ceased. Meanwhile the reservoir was being drawn down through the bypass, and an inspection was made which discovered a passage running around the north and east sides of the gate well. Excavation was then made in the 12-ft. space between the gate-well and the retaining-wall to a depth of 25 ft., and reaching the top of the inspection gallery. This showed that the water had started to follow the back of the retaining-wall several feet below the reservoir level, and had found an outlet through the embankment between the gate-well and turbine chamber, until the upper part of the fill had dropped into the passage and stopped it. This portion of the fill was 31 ft. deep, and was so blocked by counterfort walls, penstock, etc., that there was no room for horses during construction; hence the fill had been wet and hand-tamped instead of being rolled like the balance of the embankment. It was evident that this part of the fill had started to settle and had become arched in the narrow space between the gate-well and retaining-wall sufficiently to separate the fill enough to permit the entrance of water, which eventually found an outlet. Repairs included a concrete cutoff wall

below high-water level, connecting the gate-well, counterfort and top of inspection gallery. No further trouble has been experienced at this point, nor has any leakage whatever developed past the wing walls at the other end of the spillway. Evidently the embankment has settled as a unit at that point as there are no extra structures underground to interfere with such action.

The pool was pumped out for the first time when the dam had been in use for six months, and considerable débris was removed from its surface. When first unwatered, it was found that about one-third of the weep-holes in the floor were in operation to a greater or less extent, but that in about one-half the spaces beneath the arches the weepers had become stopped so that portions of the floor were under an uplifting pressure due to 13 ft. of water, provided there was free connection between the spaces under the arches and such portions of the floor as contained inoperative weepers. Work was at once commenced opening clogged weep-holes in the vertical slabs as well as in the floor, but on the second day the central portion of the floor slowly raised like a huge blister to a height of about 6 in., and many additional weep-holes came into play, spouting in places to a height of 4 ft. The discharge through the weep-holes continued for several hours, until the floor gradually settled back into place.

No damage was apparent to the structure, although the ribs or "toe-holds" holding down the ends of the planks were cracked on top in several places, and two of them were somewhat shattered on the upper surface at the upstream end, where they must have been subjected to an enormous end thrust due to "toggle" action when the floor settled back into place. This incident demonstrated the necessity for weep-holes and justified the placing of considerable reinforcement in the concrete floor slab. Before flooding the pool again all the weep-holes in the vertical slabs were opened up, and many of them were surrounded at the rear end with pockets of crushed stone. The pool has been unwatered subsequently upon several occasions with no mishap. It is found that with all weep-holes working in the vertical slabs the water behind them drains nearly as fast as the pool is lowered.

The structure was designed jointly by E. G. Hopson and the writer, and the latter had general charge during construction.

Cantilever Canopies for Platform Shelters on the Chicago Elevated Railways

In the enlargement and improvement of stations on the elevated railway loop in Chicago, the Northwestern Elevated Ry. is using cantilever supports for the platform shelters, instead of the center columns used in the original construction.

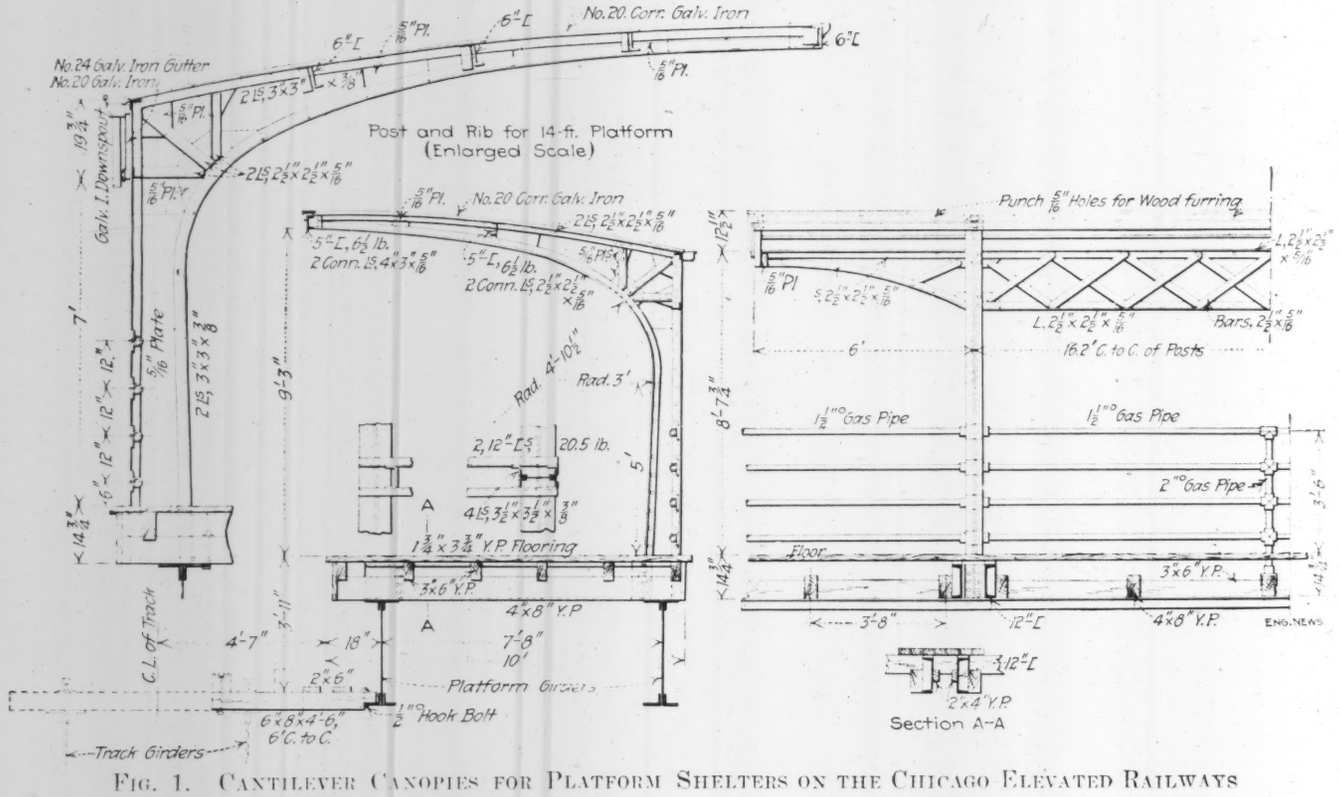


FIG. 1. CANTILEVER CANOPIES FOR PLATFORM SHELTERS ON THE CHICAGO ELEVATED RAILWAYS

This cantilever design was first used in 1907 on the Ravenswood Division, and it has proved so advantageous that the center column construction has been abandoned by this road, thus eliminating columns which are specially objectionable on narrow platforms. It is found easy to employ the cantilever design for wide platforms, and the greatest width of platform on the elevated loop is 14 ft. The design is shown in the accompanying cut, and for drawings we are indebted to C. M. Mock, Chief Engineer of the Northwestern Elevated R.R.

The post and roof rib are composed of four flange angles, with a web plate in the post, and angles at the junction of the post and rib. The bottom of the post fits between a pair of channels which rest across the platform girders. The posts are spaced 16 to 17 ft. apart,

are connected at the top by a line of purlin trusses, while light channel purlins extend between the ribs. In the wide roof over the 14-ft. platforms there are four lines of 6-in. channel purlins, while for the 10-ft. platforms there are two lines of 5-in. channels.

The carrying out of this work in crowded streets and along a line having a continuous service of trains, involved a number of special problems. In lengthening the platforms, the new girders were hauled to the street and hoisted by a light timber derrick or "monkey" having a 36-ft. post 8x8 in. on a 16-ft. sill 6x8 in., and stiffened by 24-ft. side braces, 3x8 in. The sill rested on the street surface, and the head of the mast was guyed from the railway structure. The girders were swung into place, standing on the projecting ends of the cross-girders which carry the track stringers, the hoisting cable being led to an electric hoist with 25-hp. motor.

FIG. 2. HOISTING A GIRDER FOR PLATFORM EXTENSIONS

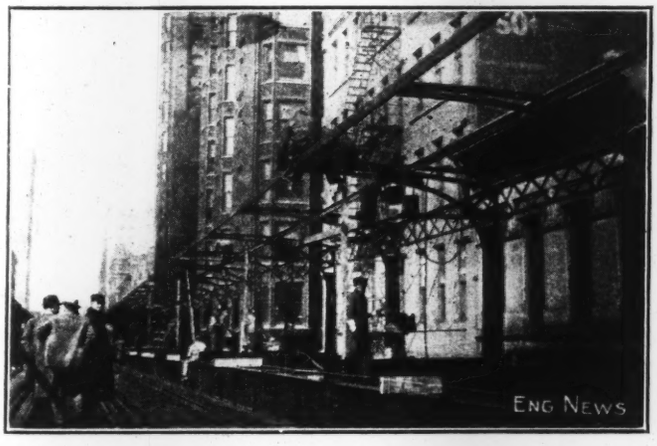


FIG. 3. BUILDING NEW PLATFORMS AND CANTILEVER CANOPIES BETWEEN THE STATE ST. AND DEARBORN ST. STATIONS ON THE ELEVATED LOOP IN CHICAGO

A similar but much smaller hand derrick was then placed on the new girders and hoisted the L-shaped canopy supports, the pairs of channels for the platform framing, the sway frames and lateral bracing and other material. Fig. 2 shows a girder being hoisted by the "monkey" derrick, and Fig. 3 shows the erection of the canopy. The heavier parts were hoisted on the side where they were to be usd, but some of the planking, corrugated roof sheeting, etc., was carried across from one side to the other. To protect the trains and workmen, a flagman was stationed on the narrow walk between the tracks and signaled trains past the work.

For the riveting, a portable compressor outfit was used, consisting of a gasoline engine and compressor mounted on a horizontal receiver, which in turn was mounted on a wagon frame and wheels. This stood at the curb in a side street, and adjacent to it was a tool wagon. The contractors for this work are Bergman & Lotts, of Chicago.

The Fertilizing Value of Sewage and Sewage Sludge

Although there is still little immediate hope of recovering fertilizing material from sewage without far more expense than revenue, the increased demand for fertilizers and the possibility of improvements in the methods of recovery make the subject one of continuing interest. On this account, a paper by H. W. Clark,* reviewing studies at the Lawrence Experiment Station and the recent literature of sewage and sludge utilization deserves attention.

The accompanying table and notes immediately following summarize studies made in 1912 of "the fairly strong [for America] domestic sewage of the city of Lawrence," Mass.

AMOUNT AND VALUE OF THE CONSTITUENTS IN 1000 GAL. OF REGULAR SEWAGE OF LAWRENCE, MASS., IN 1912

	Parts per 100,000	Totals and values Lb.	Cents per lb.	Value, cents
Nitrogen as free ammonia	3.20	0.27	16.0	4.3
Kjeldahl nitrogen	1.08	0.09	10.0	0.9
P_2O_5	1.00	0.08	5.0	0.4
K_2O	1.50	0.12	4.2	0.5
Totals		0.56		6.1

Each thousand gallons contained also about ¼ lb. of fatty matters, worth at 3c. per lb.—its approximate value—about 0.75c.

Two-thirds and more of the valuable constituents are represented by the ammonia in solution. Upon a million-gallon basis, the total value of agricultural materials in this volume is about $61 and of the fatty matters, $7.

"Average American sewage," Mr. Clark states, "contains not much if any more than 2400 lb. of suspended matter" per 1,000,000 gal., as compared with an average of 3450 lb. for ten German and English cities listed by Dr. Dunbar, Director Hygienic Institute, Hamburg, Germany.

After presenting abstracts and extracts from many sources, all giving but little encouragement for economic utilization of sewage, Mr. Clark concludes:

In conclusion, then, it is evident that the total amount of fertilizing and fatty matters in each 1000 gal. of representative American sewage is not worth above 6c. or 8c. Of this, about half is represented by the ammonia in solution, and there is no method by which this material can be utilized except by application of the sewage to land. All experience, covering many years with hundreds of well operated sewage farms ranging in size from a few acres to the vast 39,000-

*Chemist to the Massachusetts State Board of Health, Boston, Mass. The paper has recently been reprinted from Bull. Mass. State Board of Health, December, 1913.

acre farm at Berlin, Germany, has shown that only under the most favorable conditions can the return from these farms be made to pay operating expenses, and an instance is yet to be cited where these returns pay both the cost of operation and interest on the capital invested.

The exceptions, perhaps, to this are certain tracts or farms in regions of low rainfall and where the sewage is valuable as a liquid, that is, for real irrigating purposes. The Wolverhampton farm quoted in this repor t is undoubtedly a representative English farm as regards good management and cost of operation, and at this farm the actual total cost of sewage treatment is $19 per million gallons.

Much of the valuable fertilizing and fatty constituents in sewage is found in the matters in suspension. Average American sewage contains, perhaps, about 2400 lb. of sedimentable matter in a million gallons, and the nitrogen, fatty matters, etc., in this 2400 lb. of sludge are worth approximately, $15 or $18. In order, however, to reclaim this valuable material, the sludge must be dried, pressed and also subjected to a process for the separation of grease from the fertilizing constituents in the remaining body of the sludge. Only by this separation can the grease become an article of commerce and the sludge of real agricultural value. This fact is well established by long experience and many investigations. When the fatty matters are separated by any known process, this procedure is costly. Only in a few places as yet is such separation attempted as a commercial enterprise, and the profitableness of the work at these places is as yet doubtful.

When the sludge is freed, or practically freed, from fatty matters it consists of a large weight of inert mineral and organic matter mixed with a comparatively small weight of fertilizing matter, hence the cost of carriage is great even when it is well dried. It has also been well proved that the nitrogen, phosphoric acid, etc., present are generally in a less assimilable form than the same bodies in ordinary commercial fertilizers. The sludge has value, however, and as the processes of drying, pressing and fat separation are improved, and also as nitrogen advances in price, as seems inevitable, sewage sludge will become of greater agricultural value than it is at present, especially as the basis of a fertilizer enriched by the addition of potash, phosphates, etc.

A Grand Jury Presentment on Contract Work in New York

A special Grand Jury in the Criminal Branch of the New York Supreme Court, which has been investigating for a considerable time the connection between politics and contract work in New York, delivered a presentment to Justice Davis on Apr. 21, setting forth that while the jurors were morally convinced of the guilt of certain persons whose acts were investigated, the obstacles in securing evidence prevented the return of indictments. The conclusions reached by the Jury were as follows:

First—That although the Board of Water Supply of the City of New York, as created by Chapter 724 of the Laws of 1905, was intended to be an administrative board of independent men, free from all political influence and control, some of the men selected as Commissioners of the said Board of Water Supply have at times been so subject to political influence, or so incompetent, that their action in the awarding of certain contracts has been controlled and directed by political influence.

Second—That the provisions of the labor law, as now administered, with respect to public works, are such as to lend themselves to a use by the unscrupulous for the purpose of extorting "tribute" from contractors engaged upon such public works.

Third—That the employment by the said Board of Water Supply of a staff of salaried consulting engineers can only be justified upon the theory that these consulting engineers are such in fact and that when called upon for the expression of an opinion in connection with any contemplated work such opinion, when expressed, is their own independent opinion, reached by them without foreknowledge of the opinion already formed and expressed by the regular engineering staff of the said Board of Water Supply.

Fourth—That the said Board of Water Supply, constituted as it is of men of no engineering training, is obliged to accept as final, upon all engineering matters, the opinion expressed by its Chief Engineer. This places the real responsibility upon the Chief Engineer, while the legal responsibility rests upon the three Commissioners.

The Jury further said:

There is no direct evidence before us that political influence has been exerted for the financial benefit of any man now officially connected with the Board of Water Supply, but there have been occasions upon which there is reason to believe that at least one man then officially connected with the board profited by such transaction.

In concluding its report, the Jury submitted the following suggestions with reference to reforms in the letting of public contracts:

1. That the Board of Water Supply of the City of New York be reorganized in such a manner as shall place the legal responsibility of all construction and all engineering work, coming within its jurisdiction, upon a competent chief engineer, by whatever name his office may be called, who is the real responsibility now rests, and shall provide for a single administrative head upon whom shall rest the legal responsibility for all matters outside of the construction and engineering work.

2. That the former member of the Board of Water Supply, who is now the State Engineer and Surveyor, is unfit to hold public office, it being our opinion that any public officer who is unwilling to waive immunity from prosecution and testify freely before any legally constituted investigating body, with respect to his conduct while in public office, is unfit to hold office.

3. That the labor law be amended so as to give a contractor who is charged with labor-law violations an opportunity of being heard.

4. That all persons who assist in getting contracts for a contractor be compelled to file notice of such employment with the departments controlling the desired contracts, that the contractors also be compelled to file the names of their agents and that these names be a part of the public records.

5. To make conspiracy against the state in any form punishable by a fine or imprisonment or both, as the law provides in the Federal Government.

5. That a conspiracy to commit a crime constitute the same grade of crime that the conspiracy was formed to commit; that the looting of the State Treasury be hence regarded as a felony.

6. That a law be enacted making it a misdemeanor for any person to solicit a campaign contribution from a contractor engaged on public work, or for any such contractor to make any campaign contribution to any political organization of the state, a county, or municipality therein.

Bright Prospects for Road Builders in New York State—A bill recently passed by the New York State Legislature and signed by the Governor, Apr. 23, makes $5,000,000 of the state's second $50,000,000-bond issue available for immediate use and $5,000,000 more available by Oct. 1.

Forest Fire Prevention Along Railroad Lines has engaged the attention of the New York, New Haven & Hartford R.R. for some time, and as the result of experiments made in recent years the following information is given out by Edward G. Riggs, Executive Assistant.

Experiments have demonstrated that such forest fires are best prevented by clearing of underbrush a sufficiently wide strip of land on each side of the tracks. Of the total mileage of the New Haven about 500 miles lie through country where there is more or less danger from fires. The bulk of the necessary permits have been obtained and $2500 was recently appropriated for the work. The plan is to clear a strip at least 66 ft. wide on straight track and 132 ft. wide on curves. These strips are first cleared completely of all small growth and underbrush by the "brush gang," and are then kept clear by the section men. All trees are left standing, as they act as a screen for sparks. Two gangs of men are now at work between Yarmouth and Brewster. When this 25-mi. stretch has been cleared it is proposed to tackle the section between Harwich and Chatham.

The soil in the Cape Cod district in Massachusetts, where the work is under way at the present time, is dry and sandy and bears a peculiar growth of vegetation. In addition, for some years the rainfall has been far below normal. Elsewhere the principal wooded sections are in Plymouth, Bristol and Hampden Counties, Mass., in western Connecticut, and in part of Rhode Island.

On several of its lines in the dry seasons of the year the New Haven maintains a fire-patrol system. All locomotives are equipped with a spark-arresting device approved by the Massachusetts Commission. This device is a wire-mesh arrangement designed to catch the sparks and must be inspected at every trip.

Editorials

A Civilian Engineer for the Alaska Railway

If there had been previously any doubt as to whether an army engineer should be chosen to take care of the construction of the Government railway in Alaska, the events of the last few days have swept the doubt away. The government may need all the officers of its regular army for its military operations in Mexico. The task which the government is to undertake in Alaska should by all means be entrusted to a civilian engineer, and we may add, to an engineer whose experience and past record in railway construction has been such as to insure that the Alaskan work will be carried on with a high degree of skill and intelligence.

Unfortunately, the public has little comprehension of the great importance of the work of the railway locating engineer, just as it little realizes the great importance of the work of the engineer who plans an enterprise in its broad features and determines the large questions concerning it before a spade has been put into the ground.

Upon the wisdom or lack of wisdom of the engineers who locate the Alaska railway, the success or failure of the enterprise will very largely turn. There are many able engineers of high reputation in their special fields who because of lack of experience in railroad location and knowledge of its economics would be quite as likely to make a disastrous failure, if placed in charge of the Alaskan enterprise, as would a man wholly ignorant of engineering. The only saving thing in case such a man should be selected, is that he would be better able to appreciate his own ignorance than would the layman, and would take pains to find a competent assistant to share his responsibility.

Relation of Consulting Engineers to the Engineering Staff

A special Grand Jury of the New York Supreme Court which has been investigating contract work in New York City made a presentment last week, the conclusions of which are printed on the opposite page. One paragraph at least of these conclusions appears to call for some comment in these columns. We print it as follows:

> The employment by the Board of Water Supply of a staff of salaried consulting engineers can only be justified upon the theory that these consulting engineers are such in fact and that when called upon for the expression of an opinion in connection with any contemplated work such opinion, when expressed, is their own independent opinion, reached by them without foreknowledge of the opinion already formed and expressed by the regular engineering staff of the said Board of Water Supply.

Had the citizens who constituted this jury possessed a wider knowledge of engineering organization and the conduct of engineering work it is altogether probable that the above criticism would never have seen the light.

In the first place it is to be noted that the Board of Consulting Engineers is the direct successor of the Board of Engineers which made the original plans for the new Catskill supply and its personnel is still partially identical with that original Board. There was an obvious advantage in permanently retaining the services in a consulting capacity during the continuance of the work of the eminent engineers who originally planned it.

The jury has laid down certain principles which it says should control the employment of consulting engineers; but we fail to find any sound reason why the observance of these principles is in any way essential to secure efficient work.

It will be of interest, we are sure, to set down here in detail what the relations were between the Board of Consulting Engineers and the other members of the engineering staff.

From the outset, one member of the Board of Consulting Engineers has been designated as the particular adviser of the Commissioners; but in addition he had joined with the others in counseling the Chief Engineer and his staff. To obtain the fullest measure of benefit from the advice of these eminent consultants, to avoid delays consequent upon changes in plans at a late stage of advancement and to economize expense, it has been the practice of the Board's "regular engineering staff" to discuss with the Consulting Engineers most of the important matters in their initial stages so that when the Chief Engineer's plans or opinions were finally formulated, the Consulting Engineers, having been familiar with the work in the several stages of its development, were prepared to express their sanction or final criticism promptly. Early differences of opinion were settled whenever possible by additional information, further study or argument. In the few cases of ultimate disagreement among the Consulting Engineers, the Chief Engineer was under the necessity of deciding, since his was the ultimate responsibility, under the Board.

Many details of the work, in both field and office, were taken up with one or more of the Consulting Engineers by various members of the staff, as occasion required. Necessarily, at different steps in the progress the frequency and nature of the demands upon the consulting engineers varied greatly, but as any engineer knows, who has had connection with large projects, the measure of the value of the services rendered by such men is not always the number of hours apparently spent on the work. Being men of broad and ripe experience, sound judgment and recognized ability, they were frequently consulted upon matters of policy and administration as well as upon technical subjects.

It is doubtless true that the eminent members of the Board of Consulting Engineers are so well known to the profession that they need no defense in these columns. It seems proper, nevertheless, in defense of the engineering profession that the facts should be here set down, especially as the aspersions of the jury reflect upon the character and fair name of the great engineer who has only recently departed from us, the late Alfred Noble,

whose signal service to his country throughout his long life and whose character for absolute honor and integrity are a prized possession of the engineering profession.

A Herculean Job of Submarine Pipe-Laying

Of all the difficult tasks undertaken and successfully accomplished by the corps of able engineers which have carried out the works in connection with the new Catskill water-supply for New York City, we recall none which will involve greater and more serious difficulties than the task of laying a submarine pipe across the Narrows, the details of which are described elsewhere in this issue.

The laying of submarine pipe across rivers has come to be pretty well standardized so far as pipes of ordinary size are concerned. As has been frequently described in the columns of ENGINEERING NEWS, special cast-iron pipe is used, made with ball-and-socket joints. The lengths of pipe are connected up one after another on a floating barge, and the line of pipe is allowed to gradually slip off the end of the barge down an incline into a bed dredged for it on the bottom of the river. In the case of pipes of ordinary size laid across navigable rivers of moderate depth this process involves no particular difficulty and long experience has shown it to be perfectly reliable. So far as our knowledge extends, however, this process has never been applied to any such enormous pipe line laid in such a great depth of water as is now proposed to be undertaken at the Narrows.

Across this busy channel in a depth of 60 ft. of water a line of 36-in. diameter cast-iron pipe is to be laid, and the method planned for laying is substantially similar to that adopted for laying pipe of ordinary size, with such changes in detail and such careful study of special problems of design as are made necessary by the magnitude of the task. This big pipe line will weigh nearly 800 lb. per lin.ft. While it is being laid, the line of pipe extending from the pipe-laying barge to the bottom of the river will probably have a weight in deep water of something like 80 tons.

The pipe-laying barge will be exposed to heavy seas in the case of high winds, for while the Narrows is too far from the bar to feel any effect of the ocean swell, there is a wide area of water in the harbor on which a high wind can raise waves of respectable size. The tidal currents in the Narrows are also very rapid and it will require very stable anchorings to hold the pipe-laying barge in position and prevent its being carried out of line.

The whole work is in fact so far out of the ordinary experience of engineers and contractors that it is not at all strange when bids were invited that ordinary contractors allowed a wide margin for risks in connection with the task. The lowest bidder proved to be the Merritt & Chapman Derrick & Wrecking Co., which from its experience in handling marine work, is better able to judge of the risks in connection with this interesting task than any ordinary contractor. Its bid for the work was just short of a million dollars, at which price the crossing from Brooklyn to Staten Island will cost in the neighborhood of $250 per lin.ft. To put it in another way, the crossing will require something like 4000 tons of cast-iron pipe, and when this is laid in place it will have cost the city of New York about 8c. per lb. These prices, of course, represent not by any means the cost of the material, but the cost of the plant and machinery and labor and risk involved in putting the pipe in place in the bed of the river.

It is a very interesting engineering question whether under the circumstances a tunnel under the Narrows would not have been preferable to this submarine pipe. Without doubt, the able engineers of the Catskill Aqueduct were as well equipped as any set of engineers possibly could be to closely estimate the cost of such tunneling in view of the fact that they have just about completed the longest stretch of underground tunnel in the world.

If a tunnel were driven under the Narrows, it would have to be either a soft-ground shield tunnel driven through the mud and silt at moderate depth or else a very deep rock tunnel connecting with the deep rock tunnels in Brooklyn. Had a cast-iron-lined tunnel been driven with a shield, it would, of course, have been necessary to have made it large enough to have laid the water pipe through it after completion. The driving of such small-diameter shield tunnels is easy and safe compared with the driving of shield tunnels of large diameter, as is well known. The chief difficulties come where the tunnel changes from soft ground to rock on either side.

We have no doubt and in fact are informed that the Catskill Aqueduct engineers gave careful consideration to the relative merits of tunnels and submerged pipe before deciding upon the latter, and with full regard to the difficulties involved in the choice. The unvarying success which has followed their work thus far from its beginning is at least fairly good evidence that, so far as can be determined in advance, their choice was a wise one.

Standard Specifications for Water-Works Hydrants

At its recent meeting the New England Water Works Association adopted standard specifications for water-works hydrants, following the example of the American Water Works Association, which adopted standard hydrant specifications at its meeting in Minneapolis in June, 1913.

The specification adopted by the New England Association does not differ very materially from the American Water Works Association's specification, which was printed in our issue of Aug. 7 last. Since this is the case, it is all the more to be regretted that the committee of the New England Water Works Association did not take the previously adopted specification as its basis in making its report. The specification adopted by the New England Association contains more detail with respect to a number of requirements, but in most of the clauses the requirements are practically identical in the two specifications and only the phrasing differs.

The next step which ought by all means to be taken would be for the two associations to appoint a joint committee which should take the standards that each association has adopted and harmonize them into one specification. Surely there are enough prominent water-works engineers who are members of both associations to bring about a movement so evidently dictated by common sense. It is absurd that there should be promulgated two different standard specifications for water-

works hydrants, each of them backed by a representative association of engineers. It may be added that the discussion at the New England Association meeting did not develop any important points in the specification as adopted that might not readily be harmonized with the specification of the American Association.

The one point on which considerable discussion took place was the reduction of pressure permissible in the water due to passage through the hydrant. The draft submitted by the New England Association's committee, read as follows:

> With the hydrant discharging 250 gal. per min. through each 2½-in. hose outlet the total friction loss of the hydrant must not exceed 1¾ lb. for two-way, 2¼ lb. for three-way, and 3 lb. for four-way hydrants, except when fitted with inside hose gate valves, in which cases the loss must not exceed 2¾ lb. for three-way, and 3½ lb. for four-way hydrants.

After discussion, this long and complicated requirement was amended to read that the total friction loss in the hydrant must not exceed three pounds. This is a requirement which does not appear in the American Association's specifications, but the same point is covered by requiring that the net cross-sectional area of the smallest passage through the hydrant must be at least 20% in excess of the size of the valve opening, and the further requirement that water passages through the hydrant must have easy curves with rounded corners where there is change of direction or change of size.

The importance of specifying a limit of three pounds friction loss is debatable when the difficulty of its determination is kept in mind. Further than this, the actual friction in passing through hydrants is invariably a mere trifle compared with the friction in the hose itself with any ordinary hose length. At the New England meeting a few weeks ago, the Eddy Valve Co., of Waterford, N. Y., submitted tests made by Professor Laughlin, of the Rensselaer Polytechnic Institute. These tests showed losses of pressure with an Eddy hydrant having a four-inch valve opening of only 1.78 to 1.87 lb., with a hydrant discharging from 518 to 540 gal. per min.

Another requirement of both the New England and the American specifications which is open to some question is that relating to water-hammer. The New England committee in its original draft specified that hydrants should be so designed that with extraordinary usage they will not cause serious water-hammer. This was changed before adoption to read: "They will not cause an increase of pressure in the system above normal of more than 60 lb." The water-hammer clause in the American specification is exceedingly ambiguous, but those who drafted it probably intended it to mean the same thing.

An interesting point of inquiry is whether water-hammer pressures can really be determined by the ordinary gage. It is true that a water-hammer will set the needle of a pressure gage vibrating, but whether the vibrations truly measure the intensity of the water-hammer is extremely doubtful. In fact, one engineer of long experience recently expressed the opinion that no pressure-measuring instrument he knew of would accurately and correctly record the actual instantaneous pressures set up in the pipe in the case of violent water-hammer.

War with Mexico?

It is with sad and heavy hearts that the people of the United States have during the past two weeks witnessed the successive events which have threatened to involve us in a war with Mexico. President Wilson spoke one undoubted truth when he said that the people of the United States have no enmity toward the people of Mexico. Popular sentiment in the United States is without doubt against warfare, save where war is waged on behalf of a just and righteous cause. There can be little doubt, either, that popular sentiment favors the settlement of international disagreements by arbitration rather than by war. There is, indeed, a certain effervescent, unthinking element in our population that welcomes war and its attendant excitement, and recks nothing of the consequences. But this same fickle element, well represented by a certain class of sensational newspapers, would be as prompt to turn about face and denounce the war, no matter how just its cause or how bravely it was waged, as soon as the nation was called upon to undergo the great sacrifices of men and of resources which war inevitably involves.

There is no question, of course, that the patriotic sentiments of the people of the United States will give to the government all necessary support. There is no question but that the government can secure all the men and money and material resources it needs for the effective prosecution of the war if once undertaken. But accompanying these patriotic sacrifices will be the question, already heard from one end of the country to the other, "is the object of these great sacrifices worth while?"

It seems indeed a thousand pities that in undertaking warfare against Mexico, to which the nation seems so nearly committed, it has not been clearly stated to the world what are the real causes which have brought it about. Unfortunately, we have published to the nations of the world that our military operations in Mexico have been undertaken solely to avenge an affront to our nation's flag, an affront for which, according to our own published statement, an official apology had been made and adequate punishment given to the officer responsible in the matter. Public opinion in the United States would by no means support a foreign war undertaken because of disagreement over minor details as to the form of official salute which should follow an act of aggression upon our national dignity. The idea that we can somehow make more honorable our national flag by going to war as an act of revenge for an insult thereto, is on a par with the old idea that an affront to personal honor could be only wiped out through the shedding of blood in a duel.

And it may be said further, without much fear of contradiction, that we are not undertaking war with Mexico as an act of revenge for American lives lost and American property destroyed during the civil war and anarchy which have torn that unhappy country for the past three years. The war cannot restore to life those who have been killed, and restitution for American property destroyed could be more easily obtained from Mexico in its present condition than after it had been swept by a war of conquest. In seeking therefore an adequate reason for our military operations against Mexico, we are compelled to look not to the past but to the future. It is not to compel a salute to the flag or to revenge American lives lost that we have captured Mexico's principal seaport and are proceeding with preparations to prosecute war on a large scale. Whatever the official utterances of Washington may be, the American public justifies a war with Mexico only as a means to bring to an end the con-

dition of civil strife and anarchy which has so long existed in that unhappy land. But it is this very fact which makes thoughtful citizens feel the gravest doubt and foreboding as they view the difficult task which our nation has undertaken.

Our first task—the vanquishing of organized military resistance on the part of the Mexican government—might possibly be comparatively easy. The probabilities are, however, that it would be a long and difficult one.

We would undertake a war of invasion in a country most difficult for military operations where we should be far removed from our base of supplies. With all the trouble and disaster that has been wrought in Mexico by the last three years of anarchy, it must be remembered that the Mexico of today is a far different country from that against which the troops under General Scott moved three-quarters of a century ago. The Boer war in South Africa was a revelation to the world of the extent to which a determined people, few in number, could wage successful opposition to an army of invasion backed by one of the most powerful nations on the face of the globe. We need look for no such holiday task of overcoming a practically defenseless enemy as we had in the war with Spain. We may as well school ourselves at the outset to expect defeats involving heavy losses in killed and wounded, accompanied by equal or greater losses from the ravages of disease in an inhospitable climate. There will be long delays, while we are assembling the amount of men and materials sufficient to accomplish our difficult task; nor are our military operations likely to end with the capture of the Mexican capital. We may as well expect organized opposition, attacks of guerilla forces upon every Mexican city and town that we occupy throughout the length and breadth of that vast country.

Of course, there can be no doubt of the ultimate outcome. Comparing their resources in men and money and material and power to wage war, the United States and Mexico are as a giant and a pigmy. In the end, granting popular support to the war, of which there seems no doubt, our final conquering of the country is assured. But when that end is accomplished we shall be face to face with the question "what shall we do with this conquered country?" To withdraw and leave it a prey to the forces of anarchy which are now ruining it would be merely to destroy whatever our conquering forces had left. It would defeat the very purpose for which in the beginning the war was undertaken.

We shall on that day be responsible to our own conscience and to the nations of the world for the establishment in Mexico of a stable and orderly government, and our responsibility will be a continuing one. We cannot put a dictator in power and leave him to work his will without being morally responsible for his acts.

As to the establishment of a free republican form of government in Mexico, comparable with our own, those who best know the people of Mexico have the gravest doubts as to the possibility of such an achievement, save at the end of a long term of years of popular education and the operation of civilizing forces.

It is almost needless to say here that, the people of the United States, with the possible exception of some portions of the far Southwest, would oppose the incorporation into our own national life of the lands and the peoples lying south of the Rio Grande. We would not undertake the conquest of Mexico to annex its territory to our own. Popular sentiment would oppose such acquisition of territory on any terms. We might indeed be compelled by force of circumstances to administer the government of Mexico for a long term of years, even as we have been in the Philippines; but there would be no more popular favor toward the admission of such territory as independent States of the Union than there is for the admission as States of our insular possessions.

It is with a great feeling of relief that the country has hailed, in the last few days, the news that an adjustment might yet be reached of the present difficulties without further resort to arms. In the negotiations for such adjustment, it is to be earnestly hoped that our government may place its emphasis, not on affronts to our national honor, nor on the support of one or the other of the contending factions, and personalities in Mexico, but on the restoration of peace and order in that country, so that the thousands of Americans and Europeans resident there to whom we owe the obligation of protection, shall have assurance of safety and justice in the future.

Letters to the Editor

Economic Dredging Machinery

Sir—Your editorial in the issue of Apr. 9, 1914, on "What is the Cheapest Type of Excavating Tool" seems to call for a discussion of types of excavating machinery other than the steam shovel. There is no doubt that in certain formations, this type of machine is the most efficient but in other cases, it is far surpassed by others. Also, it is not always the case that the large units work with the greatest economy. Illogical as it may appear, many a dredging contractor operating several 1- to 1½-cu.yd. dredges and perhaps one 4-cu.yd. dredge will make the statement that the small dredges make him enough profit to enable him to keep the big dredge in operation. One real advantage that the large unit has over the small one, in addition to handling more material per dip, is that it can bring great power to bear at a single point when required. This is of especial advantage in digging in stumpy ground, excavating hard pan, working in ledge rock and loading cars in quarries and gravel pits. In fact, in nearly all operations calling for the use of trains, the large-unit machine has a great advantage in that it can load quickly, avoiding the loss in time of train crews and equipment.

On account of its ability to handle certain classes of work to better advantage and other jobs that the smaller plant could not handle at all, the large dipper-type steam shovel or dredge is most often selected but there are

many jobs which can be handled more economically by comparatively small, gravity-swing grab-bucket dredges. These may be either land machines or floating dredges. The floating machines of this type were described in my article in ENGINEERING NEWS, Aug. 14, 1913, p. 300.

In support of my contention that the grab-bucket machine is an economical excavating tool, I quote the following detailed statement of operation covering a run of 15¼ months of a 1½-cu.yd. orange-peel dredge:

Operating Charges		
Labor (double shift)	$6,458.64	
Fuel	4,776.09	
Main hoisting cables	1,011.04	
Repairs and renewals (other than cables)	2,184.19	
Lubricating oil	280.08	
Miscellaneous supplies	357.36	
General (includes board of crew and operation of gasoline tenders, etc.)	2,175.41	
Estimated amount of supplies used in above time, but paid for by vouchers of following month (liberal estimate)	1,200.00	$18,442.81
Miscellaneous and Overhead Expenses		
Proportion of cost of running main office and engineering force	3,050.00	
Interest on cost of dredge at 5%	1,080.00	
Depreciation at 6%	1,300.00	
Depreciation and interest on house boat, fuel barges and other auxiliaries	600.00	
Insurance on dredge and auxiliaries	528.00	6,558.00
Total cost		$25,000.81
Total material excavated	924,204 cu.yd.	
Cost per cubic yard	$0.026	

It should be stated in explanation of the above extremely low costs, that the material excavated was unusually well suited to the type of dredge used, being a light-weight muck over a soft clay. Occasional sand deposits were encountered but these formed a very small percentage of the work. The measurements of material handled were taken in excavation. Operating charges are from actual cost records excepting estimate shown as last item. Overhead expenses are estimated but are approximately correct. Wages were somewhat lower than those paid in most Northern states. Oil was used for fuel until the cost came to $1.25 per bbl. delivered at the head of the canal, when coal was substituted. As I remember it, this cost about $4 per ton on board barge.

A. M. SHAW.

1003 Hibernia Bank, New Orleans, La.,
Apr. 14, 1914.

Notes on the Use of Engineers' Instruments

Sir—After two years' experience on construction work, may I add one point to Mr. Showalter's excellent article in your issue of Apr. 9, p. 796, for the "young engineer, fresh from college"? The point I wish to emphasize is to keep the thumb-screws on the level "fairly loose." I do not mean by "loose" that the instrument will be unsteady; but so the thumb-screws do not in the least degree "bind"; and so the slightest motion will bring the instrument into "dead level."

There appears to be a tendency among young engineers to keep the thumb-screws quite tight against the plates; and it is this practice I wish to discourage. Of course, this comes with experience; but the young engineer should start his career with the motto "don't let any thumb-screws bind."

CHARLES E. CLARK, JR.

45 Jaques Ave., Rahway, N. J., Apr. 10, 1914.

Salaries of Instrument Men and Clerks of the Canal Zone

Sir—The discussion of "A Comparison of Salaries of Instrument Men and Clerks" on the Canal Zone, appeals to me. The correspondents C. E. and H. M. C. of your issue of Mar. 26, have read into the words "college graduate," meanings which were never intended. I take it that E. A. V., Jr., meant by the term a man who has graduated from a college or university whether he is one year out or 40 years out. But, according to C. E. and H. M. C., a man graduates from being a "college graduate" when he gets over being "green" and "inexperienced." There may have been some green graduates here who were receiving salaries ranging from $125 to $250; but in general, such salaries went to men of some experience.

The inexperienced graduates at the Isthmus received $83.33 and were rated as rodmen. Although thus rated, it was the rare exception for one of them to run the rod. The work they did was to run either the transit or level. The real rodmen of the Isthmus were colored men from the British West Indies.

Clerks in an organization have useful functions to perform as well as have engineers, and no engineer begrudges them their salaries. If the work performed, however, is an index of the salary which one should receive, the Isthmian Canal Commission certainly treated with more favor the lower ranks of the clerical force than the lower ranks of the engineering force. I know of no clerk who received less than $100 per month.

A lot of the work which was done by clerks receiving $125 and over, could have been done just as well by the men rated as rodmen and receiving $83.33. These clerks, however, could not have done the work required of the $83.33 rodmen.

How would H. M. C., who as an engineer wants to see "fair comparisons," like to go out in the bush, run a transit or a level, and come home soaked for $83.33, and see a clerk who sits comfortably under cover all the time adding and transcribing figures, receive $100? C. E. wants to absolve the Commission from violating "established practice." E. A. V., Jr., never accused it of that. Rather, it should be accused of sticking to governmental "established practice" of paying to clerks more for value of work performed than to engineers. I wish to refer C. E. to the first editorial in the issue of ENGINEERING NEWS in which his letter appears.

A. P. C.

Panama, R. de P., Apr. 11, 1914.

The Economics of Brick and Macadam Pavements

Sir—Referring to Gov. Glynn's message on New York State roads, printed in your issue of Apr. 2, 1914, in which he computes the great saving of the permanent road pavements over the cheaper ones, there is one important factor in making this comparison which has been omitted.

There is no doubt that the cheaper macadam pavements are used to a great disadvantage in some cases; however, the proper economic relation between the two types of pavements cannot be shown without taking into

consideration the relative differences of time between the several expenditures involved.

Quoting from the Governor's message:

The total expenditures for 20 years on a macadam road amount to $36,000. This includes $12,000 for building, $18,000 for maintenance and $6000 for rebuilding at the end of first ten years. The total expenditures for 20 years on a vitrified brick road amount to $26,000 if we allow a maximum of $25,000 for building and $50 a year for maintenance. On these outside figures the difference in cost for 20 years between the macadam and brick roads shows a balance of $10,000 in favor of the brick road even if New York pays the market price for brick.*

The assumptions of this problem are: (1) that one mile of bituminous-macadam costs $12,000; (2) that its maintenance involves an expenditure of $1000 a year, and with this maintenance the life of the road will be ten years; (3) that in the eleventh year $6000 will be expended for a new road, and that during the following ten years, $1000 will be expended for maintenance as for the first ten years.

The alternate for the above is to build a one-mile brick pavement at an initial expenditure of $25,000, and an annual expenditure for maintenance of $50 for 20 years. Money for this purpose is generally raised by a bond issue or short-term notes, and for the purpose of this problem we will assume that it can be had at 4%. Considering the one mile of pavement and computing the justifiable present expenditure to save $1000 per annum for macadam repairs for 19 years at 4%, there results $13,130. Add to this present justifiable expenditure to secure a return of $6000 at the end of ten years or $4056. The justifiable present expenditure plus the initial cost of the macadam road gives $29,186.

The present justifiable expenditure to save $50 per year for 19 years is $656. This expenditure with the initial cost of the brick pavement gives $25,636, a balance in favor of the more permanent pavement of $3550. The $3550 per mile would save about $26,000,000 on the 7309 miles of road yet to be built.

There are two ways in which the above result is in error, or rather is misleading. First, with a given initial expenditure there will be approximately half the mileage of the brick road built that might have been built if macadam were used, and correspondingly fewer people will be benefited. Second, the cost $12,000 for the macadam and $25,000 for the brick does not show the true relation of the cost of the wearing surfaces, for both costs include excavation and grading, which may be assumed approximately the same for both types of road.

The second surfacing for the macadam road was taken at a cost of $6000 per mile, which seems a reasonable average estimate. This would leave on the first construction $6000 for grading and excavation; using the same for the brick pavement, there results a cost of $18,000 for the wearing surface. To make a better comparison of the two types we may use $6000 as the cost of the wearing surface of the macadam and $18,000 for the cost of the wearing surface of the brick. Following out the above process there results a present justifiable expenditure for the 20 years of $23,186 in the case of the macadam, and $18,656 for the brick, giving an approximate difference of $4530 per mile in favor of the brick.

The expense of maintaining and rebuilding either of the above types is tremendous when the great mileage of New York State is considered. If the good-road hobby persists for years to come as it has in the last ten years, the coming generations will inherit a public debt beyond all reason. There is but one way in which this great debt can be kept within bounds, that is to put the State trunk highway under a toll system with prices so regulated that maintenance, interest and a sinking fund can be provided.

G. L. BILDERBECK,
Assistant Engineer, Rivers, Harbors & Bridges Commissions.

New London, Conn., Apr. 16, 1914.

*See "Engineering News," Apr. 2, pp. 752, 753.

The Responsibility of Architects, Engineers and Contractors under the Quebec Law

Sir—I read with great interest W. L. Benham's letter in ENGINEERING NEWS, Mar. 26, 1914, p. 692, on a contract which compelled the engineer to furnish a bond to the amount of 20% of the estimated cost of the work, as a guarantee of the accuracy of his estimates and the quality of the work. I quite share Mr. Benham's views on the subject and consider that your editorial of June 5, 1913, and Clarence W. Hubbell's article as quoted in your issue of Apr. 9, 1914, p. 779, are very much to the point. In reading these various articles, I have been wondering what you would think of the following law, which is in force in the Province of Quebec.

1688. If a building perishes in whole or in part within ten years, from a defect in construction or even from the unfavorable nature of the ground, the architect superintending the work and the builder are jointly and severally responsible for the loss.

It has been held by courts in this province that this article applied also to the engineer.

This law was copied from the Napoleon Code, but for some unknown reason, it has been made stricter than the French law which I translate below.

If a building constructed under a lump sum contract perishes, in whole or in part, from a defect in construction or even from the unfavorable nature of the ground, the architects and the contractors are responsible for the loss during ten years.

In order to protect themselves against the decennial responsibility the French architects insure their buildings. The insurance companies "la Zurich" and "l'Occident" write policies covering this risk, but no company in the Province of Quebec seems willing to take the risk imposed by our article No. 1688.

ARTHUR SURVEYER.

Montreal, Que., Apr. 11, 1914.

[The Quebec law reminds us very strongly of the Babylonian building regulation in force more than 4000 years ago (see ENGINEERING NEWS, Jan. 4, 1912, p. 36):

CCXXIX. If a builder build a house for a man and has not made his work strong, and the house has fallen in and killed the owner of the house, then the builder shall be put to death.

CCXXX. If it kill the son of the owner of the house, the son of that builder they shall kill.

CCXXXI. If it kill the slave of the owner of the house, a slave equivalent to that slave to the owner of the house shall he give.

CCXXXII. If the property of the owner of the house it destroys, whatsoever it destroys he shall make good, and as regards the house he built and it fell, with his own property, he shall rebuild the ruined house.

CCXXXIII. If he build a house for a man and did not set

s work, and the walls topple over, that builder from his own money shall make that wall strong.

It is evident that the Quebec law has the quality of antiquity at least.—Ed.]

The Greeley Poudre Irrigation District, Colorado

Sir—In your issue of Jan. 1, you published an article by Arthur P. Davis, Chief Engineer of the U. S. Reclamation Service, discussing the relative cost of irrigation work carried on by private companies and by the Government. In this article occurred the following reference to the Greeley Poudre Irrigation District.

I am reliably informed that the present issue of bonds is $5,100,000; that the bonds not sold are held as a bonus by the promoters, and that no water has yet been delivered to the lands.

As the Counsel for the Greeley-Poudre Irrigation District, I would state after conference with Mr. Davis that I find the above statement was made by him upon information which he received and which he had reason to believe to be reliable, but which, evidently, was in error. The bonds of the Greely Poudre Irrigation District not sold or disposed of by the district and aggregating approximately $2,390,000 out of the original issue of $5,100,000 are held by the district in its own control and therefore the statement "The bonds not sold are held as a bonus by the promoters" was erroneous.

The district construction has, in large measure, been temporarily suspended during the trial of the case of Wyoming vs. Colorado, which involves the water rights to be used by the district for the reclamation of its lands, but the district has not abandoned the project.

I am satisfied that Mr. Davis' statements were made in good faith and with no intention to injure the project or the securities issued upon it.

I should add that I am referring only to the district finances and not to the internal affairs of the construction company which undertook the construction work on the project, as to which I knew nothing.

The engineers' estimates on the system contemplate that the cost will not exceed from $1,200,000 to $1,500,000 for full completion. The work, even under the present conditions, is progressing, although slowly.

Delph E. Carpenter,
Attorney for Greeley-Poudre Irrigation District.
Denver, Colo., Apr. 11, 1914.

[Proof of Mr. Carpenter's letter was submitted to Mr. Davis, who makes the following reply.—Ed.]

Sir—On the showing made by Mr. Carpenter, I am satisfied that the statement above quoted, referring to the bonds, was an error, which I am very glad to correct.

A. P. Davis,
Chief Engineer, U. S. Reclamation Service.
Washington, D. C., Apr. 22, 1914.

A Labor Union for Engineers

Sir—Engineering News has published recently a number of letters and editorials regarding the compensation of engineers. This is quite fitting, for the salary is just as important to an engineer as the amount and quality of the engineer's services are to his employer.

Organization is the clearest and best means of obtaining a fair compensation. A union has been suggested and affiliation with the American Federation of Labor. Possibly, but is there not something better? Why not a union with our employers? The scheme is this: Form a union or league of every person in the engineering and industrial field, who is, or ever may become, an executive head. Make him a member the day he graduates from college or the day he emerges from the ranks as a foreman or petty official. Draw up a scale of union wages, pledge the members to exert every influence to maintain the schedule for themselves and for every engineer under their charge.

Let engineers, employers and executives work together for a larger compensation for the man who plans and for the man who by long study and faithfulness has fitted himself for the difficult problems of the engineer.

As the young foreman, rodman or draftsman works up into better positions, let him work for better pay for his fellows.

M. W. F.

Culebra Cut, Canal Zone, Apr. 4, 1914.

Internal Stresses

Sir—Mr. Gilchrist's analysis of principal stresses on p. 549 of your issue of Mar. 12, can be represented very simply by a graphic method due, I believe, to Prof. R. H. Smith.

Eq. (5) may be written

$$p_1 \text{ or } p_2 = \frac{px + py}{2} \pm \sqrt{q^2 + \left(\frac{px - py}{2}\right)^2}$$

Eq. (6) may be written

$$\tan 2\theta = \frac{q}{\frac{px - py}{2}}$$

The construction will be clear on examination of the

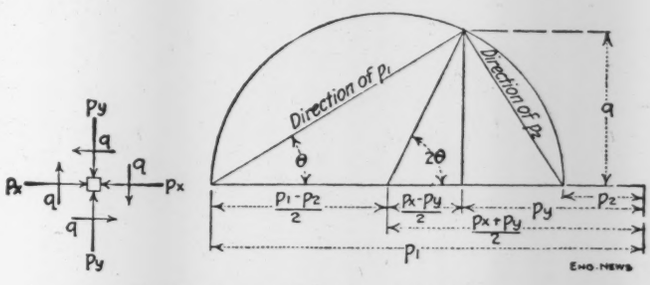


Diagram for Internal Stresses

accompanying diagram which has been drawn for the special case when p_1, p_2, px and py are all compressive stresses. The radius of the circle equals

$$\sqrt{q^2 + \left(\frac{px - py}{2}\right)^2}$$

and represents the value of the principal shear stress accompanying the principal direct stresses p_1 and p_2, as it equals $\frac{p_1 - p_2}{2}$.

W. A. Green.

27 a Elsham Road, Kensington,
London, W., England.

"Not Perpetual Motion but Near It"

Sir—The above title in large letters was displayed on a page of the Cleveland *Plain Dealer,* of Mar. 29. Below it were large portraits of the inventor and his "automatic motor." To an engineer who understands what the principle of the conservation of energy means, these often recurring schemes for lifting oneself by one's boot straps are a source of amusement. There is another side to the picture, however, when one considers the disappointment of the small investor who is induced to place his hard-earned savings in an enterprise that can produce nothing but failure. That the newspaper article under the above title was likely to deceive the ignorant may be judged from the following extracts:

An automatic motor has at last been perfected, and by a Cleveland man. That within four or five months this wonderful machine will be on the market, furnishing power wherever power is wanted, is the inventor's statement. His statement is not backed alone by his faith in the contrivance; it is backed by the sale of the United States rights to his patents, for the neat little sum of $1,000,000. His statement is also backed by the $40,000,000 concern which, he says, has practically taken over the proposition.

Mechanical engineers do not scoff after they have seen the machine in operation. They marvel, and call it the mechanical wonder of the age, and predict that it will revolutionize the process of furnishing power.

For obvious reasons; the details of the motor cannot be discussed; the motor, however, runs by 16 springs, each one of which can be held in the palm of one's hand. While fifteen of these springs are furnishing power and unwinding, they are also winding the sixteenth spring. When this spring is wound it at once starts unwinding and furnishing power, and the next spring in the series is then wound, and so on, in an endless succession. This gives a far more economical engine than the steam or gas engine. The cost of the springs is very slight—10c. a spring for a 10-hp. motor.

The sixteen-spring motor furnishes about 10 hp; the inventor says a machine of 10,000 hp. is practical.

The uses that this motor can be put to are numerous. It can be used in watches, or battleships, locomotives, street cars, automobiles or airships. The problem the transatlantic aviator needs consider is how to carry enough fuel to make his trip; none other bothers him now. Perhaps this invention of a Cleveland man will solve the problem for him. Perhaps it will carry the first man to the North Pole in an airship.

The inventor pulled out one of the springs that he would use in his larger machines; it was no bigger than a dinner plate; surely enough of these could be carried along easier than tons and tons of gasoline.

The writer had curiosity enough to investigate the machine thus exploited. The inventor received me cordially until he saw that I was an engineer, when he became cautious. The motor itself was not to be seen, but the inventor said he would have a demonstration of it in about a month to which newspaper men would be invited. I suggested that he might request the Cleveland Engineering Society to name two of its members to run a test on the machine, but he did not grow wildly enthusiastic over this proposition.

The question is often asked by engineers, Why do newspapers give free publicity and large space to absurdities of such a sort while inventions of great importance in the engineering field, which are being developed all the time, go almost always unnoticed in the newspaper press. My curiosity was sufficient to ascertain how such an article got into the paper. The explanation is simple. The member of the *Plain Dealer* editorial staff who wrote the article said he was only looking for a good story and did not think people would buy stock in the motor because of what they had read in his journal.

A side light upon the reliability of the inventor of the motor is his statement, made to two different parties, that Dr. Howe, President of the Case School, had been to see the motor and was favorably impressed with it. The fact is that Dr. Howe has neither seen the machine nor made any statement concerning it.

What is the duty of the individual engineer or the local engineering society in cases of this sort? The code of ethics of the American Society of Mechanical Engineers says:

The engineer should discourage the appearance of untrue, unfair or exaggerated statements on engineering subjects in the press or elsewhere, especially if the statements may lead to or are made for the purpose of inducing the public to participate in unworthy enterprises.

If engineers and engineers' organizations would exert their influence to stop the defrauding of the public by fake inventions of this sort, would it not make things easier for the engineer who may have a genuine invention of real technical value and desires capital for its development?

Cleveland, Ohio. Q. E. D.
Apr. 3, 1914.

[We understand Ohio possesses a "blue-sky law." There seems to be an excellent opportunity to enforce it in connection with the enterprise above described, if the description given in the *Plain Dealer* is at all accurate. —Ed.]

The Relation of Chief and Subordinate

Sir—The problem of the relation of chief and subordinate as quoted from Gifford Pinchot's book, "The Training of a Forester," in Engineering News, of Mar. 12, is an old and difficult one; but from the standpoint of those in the engineering profession it assumes a view of most particular interest.

Were we to follow the subject all through the various conditions attending engineering work, we would find those conditions far from ideal. There is more or less constant conflict in the exercise of authority and responsibility, not only between capital and the engineering organization but within the organization itself—between chief and assistant.

Quite familiar is the plaint of the Chief telling of this or that subordinate who asks him to decide the most trivial details. He cannot understand his men; they lack backbone, have absolutely no initiative and shirk responsibility.

While all this sounds very plausible from the Chief, it can truthfully be said that his own methods are often the cause of his troubles. After giving orders for an assistant to carry forward some division of the work, the Chief attempts to follow up every detail of that work not allowing his assistant the smallest range of initiative and yet placing the responsibility on the assistant. When the subordinate attempts to interpret his work according to his own judgment and "push" he is gently given to understand that he must not instill his own ideas into his work, however detailed it may be and that "push" smacks of ambition and is undesirable.

The foregoing illustrates an inconsistency, which is a weakness, and therefore destructive of the spirit of any organization. Under such conditions, the position of the subordinate is awkward and the state of his mind unde-

ded. Consequently the best in him is hardly likely to be brought out and he must depend more upon diplomacy than anything else in his relations with his superior.

M. F.

New York City, Apr. 10, 1914.

The Argentine as an Engineer's Paradise

Sir—In considering the various projects for licensing engineers, experience in a country where the "status of the profession" is excellent may well be studied. In the Argentine Republic "Civil Engineer" is purely a university title (or degree), and no one can call himself so unless he is an actual graduate of a national institution. There the word "Engineer" is used in speaking to a holder of such a degree in exactly the same way that in this country a physician is called "Doctor," and with the same degree of respect.

One of the main reasons for this condition is to be found in the government regulations requiring the signature of a certified engineer or architect on all plans presented to the municipalities for building permits, and in general on all plans of engineering works presented to the provincial and federal governments. It may be mentioned that there are few countries which exercise so intimate supervision over all types of public-service corporations as does the Argentine.

In the case of foreign engineers who wish to profit by the status of their professional brethren who are Argentines, a long and most expensive path must be followed. The writer is apparently the only American or Englishman who has had the time and patience to reach the end, and he believes that a description of the process of "revalidation" may be interesting to others.

In the first place, the original diploma issued by the foreign university must be certified to in the country of origin, before the Argentine consul, by representatives of the university or school, who must also present an official list of the holder's studies and examinations.

These are then translated by a public translator and together with a statement of practical experience are presented to, say, the National University of Buenos Aires. If accepted, the candidate must pay a fee of about $650 in American money, and shortly thereafter he will be given the program of a project to be worked out. It took the writer nearly six months to complete his, in his spare time.

This program included the design of a railroad classification yard where 300 cars daily in each direction were to be classified for various branches. The greatest freedom was left as to details, but there were called for, plans (1) of the general layout; (2) the interlocking plant for protecting passenger trains (sketch only) with the manipulation and locking tables; (3) general details of a signal tower and connections to switches and signals; (4) general plan of repair-shop annex to, and a roundhouse for 25 locomotives; (5) details of the roof of the roundhouse, which, it was stated, must also cover the turntable; (6) general plans of an elevated water tank, which the writer designed of reinforced concrete. These plans were all large drawings in many colored inks on white paper and were made in one of the drawing rooms of the University. A thesis, in Spanish, of course, about 50 pages long, described the whole project and gave the various calculations on which it was based.

About a month after presenting the work, beautifully bound in satin cloth, five professors (of subjects relating to railways) approved it in writing; and a few days later a rather perfunctory oral examination was given and the degree declared "revalidated," or the equal of their own University's diploma. The note of revalidation is written on the face of the original diploma with various stamps and seals.

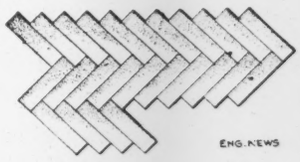
While the Argentine system is probably not adapted to the United States, it is at least the cause of the very pleasant fact, that in one country the degree of Civil Engineer is one zealously sought after and prized; if for no other reason than because of the difficulty of obtaining it. Indeed, very many wealthy young men follow the six- or seven-year course in the University merely to obtain the degree, without any intention of engaging actively in the profession.

Cyrus T. Brady, Jr.

117 Summit Ave., Mount Vernon, N. Y.,
Apr. 13, 1914.

Brick Roads in Holland

Sir—Having made somewhat of a study of the highways of Holland, it occurred to me that in view of the wide discussion on roads and highways in New York State at the present time, a brief description of our own roads would be of interest. It may not be generally known that one of the secretaries of the cabinet of Holland has the matter of roads under his control. This officer is the Secretary of "Waterstaat" (including coast defense, traffic of all kinds, roads, etc.).



Our brick roads were built more than a century ago, by Napoleon, for military purposes, when Holland was conquered by the French. These roads are composed of "klinkers," a very hard brick. They are so hard that when knocked they sound like steel. The bricks are embedded in a layer of sand, tamped or rolled so hard that a steel tool is required to cut a bed for each brick. The bricks are placed as shown in the cut. The crown is elevated $1/40$ the width of the road.

Repairs are frequent because of the movement of heavy trucks and machinery, for which they were not designed. These repairs are attended to by trained Government employees (paving in Holland is a special trade).

A road which is considered pretty good over here is a combination of the hard-baked brick and crushed stone. In the middle of the road is a narrow path of brick, and on each side a stretch of crushed-stone road. It is less costly than the brick road and its endurance is very fair. The cheapest roads are of gravel and only built where the expense of the other classes is prohibited.

William Hoeker.

24 Plaats, The Hague, Holland, Mar. 29, 1914.

The Selection of Sand for Concrete is the title of a booklet just issued by the Security Cement & Lime Co. It gives in brief form a résumé of the published literature of this rather neglected subject.

Municipal Refuse Sorting and Utilization Plant, Pittsburgh, Penn.

By Sterling H. Bunnell*

SYNOPSIS—The largest municipal refuse sorting and utilization plant in the United States, having a nominal capacity of 100 tons per day, receives, sorts out, bales and packs rags, paper, bottles and cans for marketing, burns the tailings in high-temperature destructors, utilizes destructor heat to raise steam to generate electric current for works purposes and ultimately for sale.

In the efficient and sanitary disposal of municipal wastes, Pittsburgh holds a leading position among American cities. Garbage and refuse are collected by a private corporation, the American Reduction Co., under contract with the city. The garbage is shipped to a point outside the city limits, and disposed of by the reduction process, recovering the grease and tankage for commercial purposes. The dry refuse and waste, consisting of paper, rags, waste wood, bottles, tin cans, sweepings and broken articles of all sorts, is collected by the same corporation and handled in the largest waste-picking and rubbish-burning plant ever constructed in this country.

The refuse utilization plant of the American Reduction Co. is located within the city of Pittsburgh, on Brady St., near Forbes St. The site is a side hill sloping toward the Monongahela River. The building is of reinforced concrete with a concrete slab roof supported by steel trusses and brick curtain walls.

Being located on sloping ground, it was possible to arrange the dumping floor on the fourth or top story on the same level as the approach from the Brady St. bridge. The rubbish wagons thus enter the fourth story of the building, from which point the rubbish is handled by gravity to hoppers on the ground level.

To provide space for the refuse receiving bins, transporting and sorting belt, refuse hoppers and presses, besides storage space for wagons, marketable refuse, etc., the building was made substantially 53x200 ft. in plan. In addition there is an approach across the front of the building and a wagon way at one side, both supported on concrete piers. There is also a concrete railway trestle along one side of the building (see first-floor plan, Fig. 1). By means of this railway-track connection, baled waste from the refuse-sorting plant and ashes from the destructor furnaces are quickly and cheaply removed from the premises.

The basement of the building is used for wagon storage, for engine and generator room and as a battery charging room for motor trucks. The uses of the first floor are indicated on the plan (Fig. 1) already mentioned. The second floor is occupied by the upper part of the storage bins, the upper part of the shipping room, a dining room and kitchen, picking bins and the upper part of the destructor room. The third floor is taken up with the dumping and turning room, a women's locker room and lavatory, a packing room and the top of the destructor room.

The course of the material through the plant, including the dumping of the refuse wagons, the sorting of the refuse, the baling of papers and rags, the handling of bottles and tin cans, the burning of the tailings or unsalable refuse, and also the generation of electric current from the destructor heat, are shown by the views, Figs. 2 to 10, and the descriptive titles which accompany them.

The destructor furnaces are of the Sterling high-temperature type. They were designed by the Griscom-Russell Co., of New York, under rights secured from the proprietors of the Sterling patents, Messrs. Hughes & Sterling, of Liverpool, and with the advice of Col. W. F. Morse, consulting engineer on the disposal of municipal wastes.

The furnaces consist of two units each containing two cells of 36 sq.ft. grate surface. The combination cells are top fed through circular charging holes, covered by cast-iron ring covers lined with firebrick. Air for combustion is admitted under suitable pressure by distribution pipes under the grates, and also through small openings in the iron castings which surround the grates and through the clinkering doors.

From the furnaces the gases of combustion pass to the side into combustion chambers, where the gases are turned to the back, pass through the spaces of Heine water-tube boilers and thence through a regenerator to the steel stack. The water-tube boilers are two in number, each of 250-hp. capacity, and carry 125 lb. steam pressure. The regenerators are constructed of steel tubes expanded into steel-tube plates. The flue gases pass through the tubes, and the heated air for combustion passes around the tubes and thence by proper piping to the combustion cells.

The furnaces are very substantially constructed of firebrick with a pressed-brick exterior. The buckstays are of box form, secured at the lower ends into the concrete floor, and connected at the upper ends by steel tie-rods. The furnace arches are composed of firebrick blocks approximately 9 in. square, and are carried by cast-iron skewbacks resting directly against the buckstays. The construction is thus extremely strong, and further affords the possibility of replacing the furnace arches, if ever after long use they are destroyed by the intense heat, without disturbing the walls of the furnace.

The levers and rods by which the air blast is controlled are visible on either side of the combustion cells (Fig. 9). The air-valve stems are extended upward to the charging floor above, so that the top men can shut off the air whenever they are ready to charge a furnace. This being done, the powerful chimney draft causes a slight intake of air at the charging openings and prevents the emission of sparks, with possible trouble from the rubbish catching fire outside of the furnace.

The dust in the stoking room is removed through air-suction openings over each of the clinkering doors. All the air for combustion is drawn through these openings, and the powerful suction of the forced draft blowers tends to keep the space entirely clear of objectionable dust and smoke.

*Chief Engineer, The Griscom-Russell Co., 90 West St., New York City.

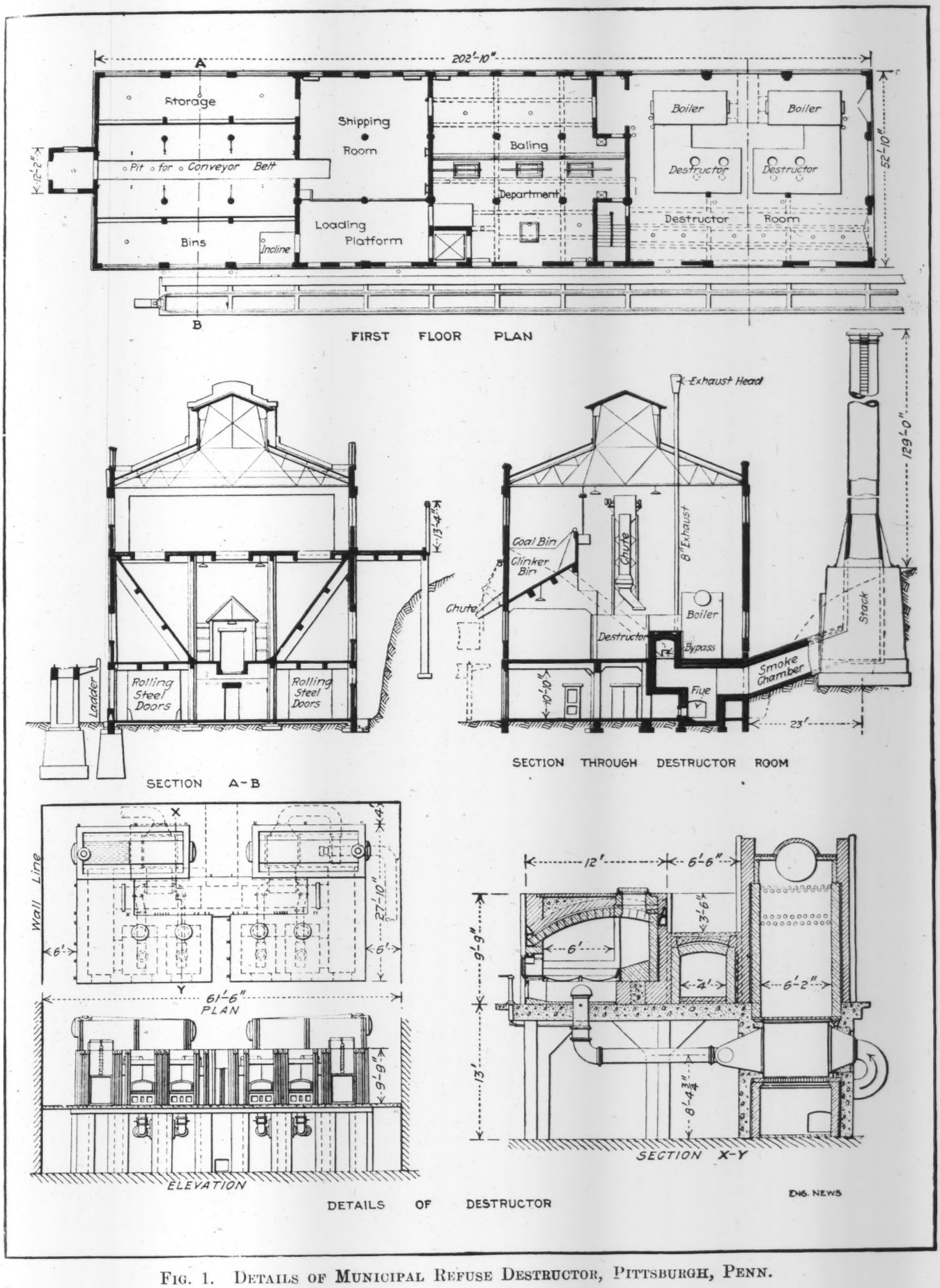


FIG. 1. DETAILS OF MUNICIPAL REFUSE DESTRUCTOR, PITTSBURGH, PENN.

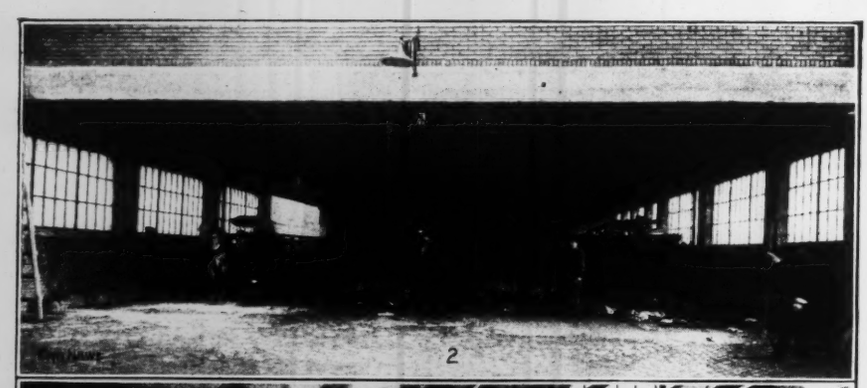


FIG. 2. DUMPING FLOOR. Three refuse wagons are in position in front of the trap-door openings through which refuse reaches the hoppers below.

FIG. 3. EMPTYING THE WAGONS. View taken at rear of dumping floor. Each rubbish wagon enters the building from the bridge level, passes over a scale where the load is weighed, and proceeds along the runway back of the building to a doorway at the rear of the dumping floor. The driver enters the dumping floor and drives forward over one of the inclosed trap-door openings. Upon reaching position in front of the opening, a short wire rope is hooked to one leaf of the trap door and to the tail-board of the wagon, and the horses are driven forward a couple of feet to open the trap door. The rear leaf is opened by hooking on the dumping rope from an electric windlass on the gallery at the rear of the dumping floor. Each rubbish wagon is provided with a series of chains attached to the rear of the wagon floor, and extending forward to the driver's seat. By hooking into a ring at the forward end of these chains, the wire rope connected to the electric windlass on the gallery serves to roll out the whole load of rubbish toward the rear of the wagon.

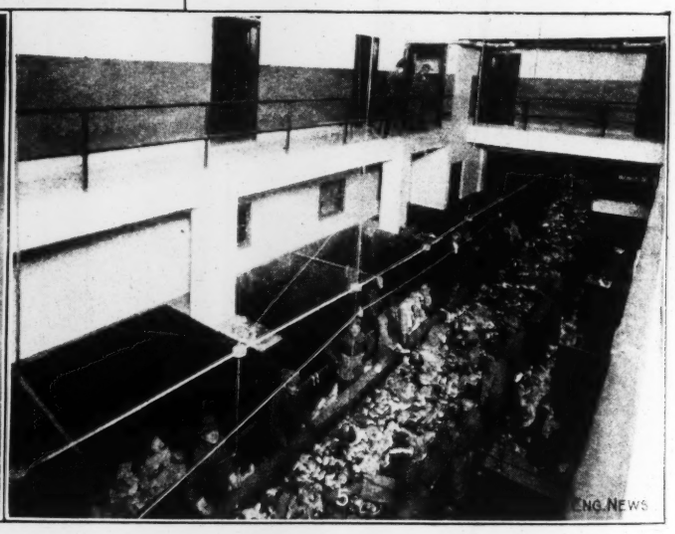
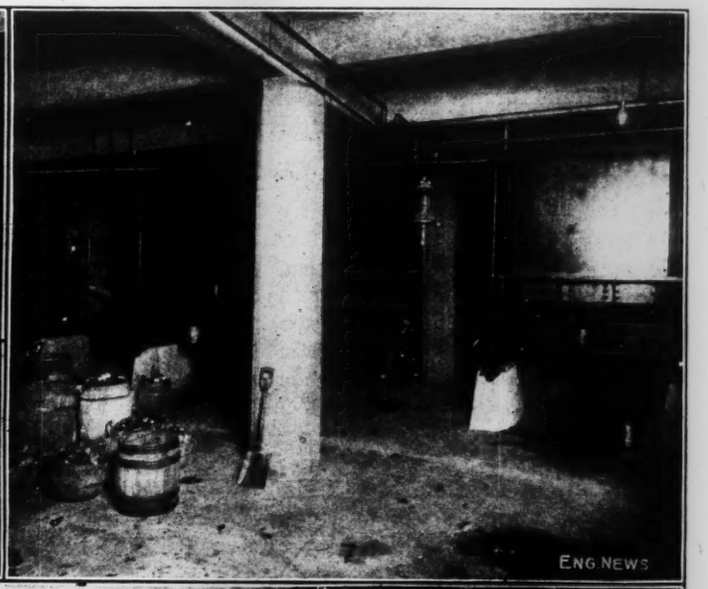


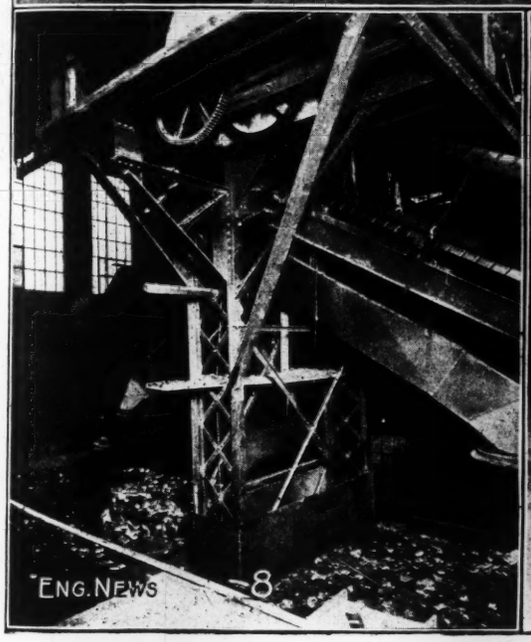
FIG. 4. REFUSE-RECEIVING HOPPERS AND TRANSPORTING BELT. Laborers pull the refuse forward onto the belt.

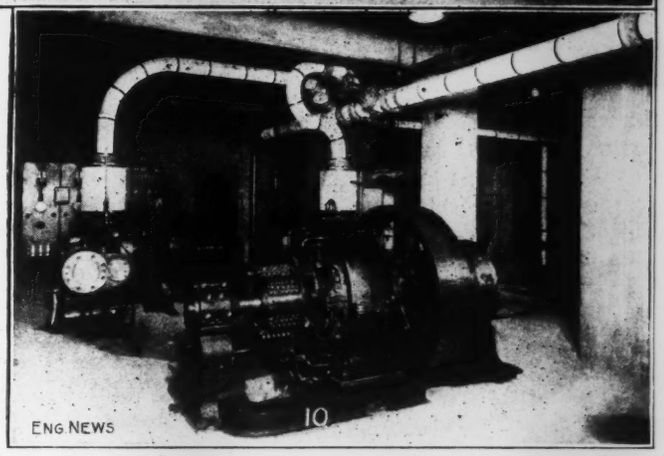
FIG. 5. REFUSE-PICKING ROOM AND BINS FOR SORTED REFUSE. The belt conveys the refuse from the receiving hoppers to the picking room. Back of the belt are bins for different classes of refuse. Groups of pickers on each side of the belt grab rags, white paper, etc., as their duty may be, and throw them into the corresponding bin.

FIG. 6. BALING PRESSES BELOW SORTING BINS. The refuse bins terminate in hoppers which lead to baling presses. The press at the right is being filled with paper from one of the bins. A second press is hidden by a column. The press at the left contains a bale of rags which has just been pressed and tied ready for shipment. The presses are hydraulically operated by plungers working in cylinders located on the floor below. The sides of the presses swing open on hinges after the bales have been compressed, thus giving access to the bales for tying. After the bale is tied the release of the plunger allows the bale to be pulled out on the side toward the railway track.

Fig. 7. RECOVERY OF BOTTLES AND CANS. Bottles are picked off the traveling belt by one of the sorters and sent down the spiral chute of galvanized steel shown in the left







background. The bottles are received on a tray of wooden slats and there sorted. Tin cans in large quantities are also picked off the traveling belt and sent down into the bin shown in the center background.

FIG. 8. HEAD OF TRANSPORTER OR TRAVELING BELT, FURNACE-CHARGING CHUTES AND FURNACE-CHARGING FLOOR. The worthless refuse or tailings pass by the sorters in the picking room and are carried up on an incline by the traveling belt and discharged into a steel hopper. From the bottom of this hopper two inclined steel chutes, with bell-shaped mouths, discharge the tailings onto the furnace-charging floor, from which they are raked through charging or feed holes into the furnaces.

FIG. 9. STOKING AND CLINKERING FLOOR. At the left is one of the combustion chambers to receive boxes, barrels and other large pieces of refuse. To the left of this column may be seen the two clinkering doors of the right-hand furnace, operated by counterbalances and wire ropes. Still further to the left is the other furnace of the set.

FIG. 10. ELECTRIC GENERATORS FOR UTILIZING HEAT FROM REFUSE DESTRUCTORS. Steam engines, electric generators and switchboards are located beneath the motor and the destructors. Current is supplied to operate the picking-belt windlasses and to light the building. At present there is a surplus of steam which has to be wasted.

HEAT FROM MUNICIPAL REFUSE AT PITTSBURGH, PENN.

The heat value of rubbish of this character is very great. The steam generated by the destructor boilers goes to steam engines which drive electric generators located on the floor below the fire room. These generators furnish current for the operation of the picking-belt motor, windlasses, blowers and lights throughout the building. There is at present a surplus of steam which blows to waste through the safety valves; but is intended to develop the power-generating capacity to the fullest possible extent by the sale of current for neighboring industries.

The entire construction work on the building and destructors was performed by the regular organization of Booth & Flinn of Pittsburgh. Irwin & Witherow, representing the Kahn system of concrete reinforcement, were the designers of the reinforced-concrete work. The general plan of the undertaking was developed by the American Reduction Co., of Pittsburgh.

The operation of a plant of this kind is likely to be, in good hands, a source of generous profits. The disposal of the salable parts of the waste involves bargaining and sale of a number of different materials. The prices secured for wastes depend largely upon the possibilities of utilization of the waste for manufacturing purposes in the vicinity of the picking plant. Demand and prices change from day to day, so that the business organization must be alert to keep in touch with market conditions, and make the most out of each article sold. The situation is peculiarly one in which the private corporation has the advantage over the municipality, in the facility with which the private concern can make bargains for purchase and sale of various commodities. The system of collecting rubbish and waste of this character separately from garbage and ashes, and disposing of it to the greatest possible advantage through the sale of all valuable portions, and the destruction of the rest in a manner to produce the maximum steam power, is meeting with increasing favor among American cities, and will eventually be adopted by all cities of sufficient size to furnish upwards of 50 tons of waste per day.

Outline of Committee Work of the American Railway Engineering Association for 1914

The work of this association is carried on by means of 21 committees whose investigations are regulated by the Board of Direction, which annually assigns to the committees certain subjects in accordance with a definite system or program. The committees do not make complete or final reports on each subject each year, but often work systematically upon one or more subjects for several years. The assignment of work for the present year is given below, in condensed form, and covers a variety of matters relative to railway location, construction, maintenance, operation and (incidentally) equipment. The President is Wm. B. Storey, Vice-President of the Atchison, Topeka & Santa Fé R.R., and the Secretary is E. H. Fritch, 900 S. Michigan Ave., Chicago.

1. Roadway. A. Unit pressures allowable on roadbed of different materials. B. Protection of slopes by sodding, etc. C. Prevention or cure of water pockets in roadbed.

2. Ballast. A. Depth of ballast to insure uniform distribution of loads on the roadbed. B. Ballast cross-sections, with particular reference to the use of sub-ballast and top ballast.

3. Ties. A. Effect of design of tie-plates and spikes on the durability of ties. B. Economy in labor and material due to treated ties. C. Metal, composite and concrete ties. D. Future timber supply of ties. E. Distribution and care of ties.

4. Rail. A. Standard rail sections. B. Rail failures. C. Special investigations. D. Specifications for material in rail joints.

5. Track. A. Double slip-crossings, double crossovers and guard rails. B. The relation between worn wheel flanges and worn switchpoints, with a view to decreasing derailments. C. The economics of track labor. D. The design of manganese frogs and crossings.

6. Buildings. A. Heating, lighting and sanitary provisions for medium-sized stations. B. The design of freight houses and shop floors. C. Rest houses for employees.

7. Wooden Bridges and Trestles. A. The relative economy of repairs and renewals. B. Docks and wharves. C. Ballasted-deck trestles. D. Lag screws for fastening guard timbers.

8. Masonry. A. Design of retaining walls and abutments of plain and reinforced concrete. B. Concrete piles. C. Surface finish for concrete.

9. Signs, Fences and Crossings. A. Economy of concrete, metal and wood for signs and fence posts. B. Methods of repainting signs and whitewashing cattle-guard fences.

10. Signals and Interlocking. A. Economics of labor. B. Switch indicators, giving information as to the condition of the block section. C. Signaling for single-track lines, and the effect of signaling and location of passing sidings upon the capacity of the line.

11. Records and Accounts. A. Revise present blank forms. B. Study reports required by Federal and State Railway Commission. C. Subdivision of I. C. C. classification account No. 6, with a view to uniformity of labor costs.

12. Rules and Organization. A. Rules for field parties on preliminary surveys, location surveys and construction. B. The science of organization.

13. Water Service. A. Design and relative economy of track tanks from the operating standpoint. B. Deep wells and their pumps, with the relative economy of this source of supply. C. Use of compounds in locomotive boilers to prevent foaming and scale. D. Pumping machinery.

14. Yards and Terminals. A. Typical plans of passenger stations (of both through and stub type), with analysis of working capacity and methods of estimating the capacity. B. Mechanical handling of freight. C. The design and operation of gravity switching yards. D. Track scales.

15. Iron and Steel Structures. A. Protection against corrosion. B. Design of built-up columns. C. Turntable. D. Relative economy of various types of movable bridges.

16. Economics of Railway Location. A. The values of grade, curvature, rise and fall and distance. B. The economics of railway operation, with a view to correcting the values given to the physical features in locating railways. C. The relative effects of passenger and freight traffic on the cost of maintenance.

17. Wood Preservation. A. Coal tar and water in creosote oil. B. Specifications of timber for treatment. C. Determining the absorption of oil. D. Results of service tests.

18. Electricity. A. Clearance limits. B. Effect of electrolysis on metallic and reinforced-concrete structures. C. Specifications for overhead transmission-line crossings. D. Maintenance organization with relation to track structures.

19. Conservation of National Resources.

20. Grading of Lumber.

21. Uniform General Contract Forms.

Sodded Slopes in Cuts have given trouble at some points on the Pennsylvania R.R., due to the sod slipping. At these points there is a good deal of soapstone clay. The sides of the cuts were finished to a very flat slope, with a berme ditch at the top, another half-way down, and the standard track ditch at the bottom. The sod was put on, and pegged in place, but in spite of all care it has been found impossible to hold the slopes in some places. At the worst places the sod has been taken off, some of the clay has been dug out, the space filled in with ballast forkings, and the sod replaced. At some points it is holding after this treatment, while at others it is not. At the time the above corrective work was done a good deal of alfalfa was sowed, and this appears to have given the best results, although it was noticed later that the face of the slope was still slipping to a certain extent.

The New England Water-Works Association's Standard Specifications for Water-Works Post Hydrants

[Adopted, except as noted, Apr. 15, 1914.]

1. SIZE.

(a) The size of hydrants shall be designated by the nominal diameter of the valve opening, which must be at least 4 in. for hydrants having two 2½-in. hose nozzles; 5 in. for hydrants having three 2½-in. hose nozzles; and 6 in. for hydrants having four 2½-in. hose nozzles, and shall be classed as one-way, two-way, three-way, or four-way, etc., according to the number of 2½-in. hose outlets for which they are designed.

(b) The net area of the waterway at the smallest part other than at the valve opening when the hydrant is wide open must not be less than 120% that of the valve opening, and there must be sufficient clear waterway through the hydrant when wide open to allow the passage of a ball at least [1⅞ in. in diameter for a two-way and 2⅜ in. for three- and four-way hydrants.]*

In new designs it is recommended that inside diameter of hydrants especially at the outlets, be 7 in. for two-way and 8 in. for three- and four-way hydrants.

(c) Hydrants must be fitted with bell ends to fit standard cast-iron pipe, the dimensions of which are given in Table I, or with flanges of standard dimensions and having standard bolt layouts, as given in Table II. Holes are not to be drilled on the center line, but symmetrically each side of it.

TABLE I

Nominal diam., in.	Classes	Actual outside diameter, in.	Pipe sockets Diameter, in.	Depth in.	Hub "a" length, in.	Hub "b" thick, in.
6	All	7.10	7.90	3.00	1.50	1.40
8	All	9.30	10.10	3.50	1.50	1.50

TABLE II

Size of pipe, In.	Diam. of flange, in.	Flange thickness at edge, in.	Diam. of bolt circle, in.	No. of bolts	Size of bolts, in.
6	11	1	9½	8	¾ x 3
8	13½	1⅛	11¾	8	¾ x 3½

Where working pressure is from 150 to 250 lb., the standard for heavy flanges must be used.

2. GENERAL DESIGN

(a) Hydrant may be of compression or gate type.

(b) Hydrants must be designed to safely withstand a working pressure of 150 lb., with a factor of safety of at least 5 at the working pressure. For example, a hydrant whose working pressure is 150 lb., must resist a pressure of 750 lb. before breaking.

(c) Valve when shut must remain reasonably tight when upper portion of barrel is broken off.

There is some danger of the hydrant being broken off, and in such cases it is desirable to have the hydrant gate remain reasonably tight.

(d) Any changes in diameter of the water passage through the hydrant must have easy curves, and all outlets must have rounded corners of good radius.

(e) With the hydrant discharging 250 gal. per minute through each 2½-in. hose outlet, the total friction loss of the hydrant must not exceed 3 lb.

(f) Hydrants must be so designed that with extraordinary usage they will not cause an increase of pressure in the system, above normals, of more than 60 lb.

(g) Hydrants must be fitted with two lugs so that the leaded joint underground can be strapped.

(h) When hydrant barrel is made in two sections, the upper flange connection must be at least 2 in. above the ground line.

In clayey soils where the ground packs closely about the hydrant and tends to grip it, freezing and consequent heaving of the ground would bring some strain on the hydrant, especially if there were flanges near the ground level. To overcome this effect the flanges should be put above ground and the hydrant surrounded from bottom to ground level with a 3-in. layer of gravel. About ½ bu. of small stones should be placed around the base of every hydrant to serve as a drain, unless the drip from hydrant is connected to some waste pipe.

3. MATERIAL OF BODY.

(a) The hydrant body must be made of cast iron.

4. MATERIALS.

(a) The metal for all iron castings must be of good quality, and of such character as shall make the metal strong, tough, and of even grain, and soft enough to satisfactorily admit of drilling and machining. The metal must be made without any admixture of cinder iron or other inferior metal, and must be remelted in a cupola or air furnace. The castings must be smooth, free from scales, lumps, blisters, sand holes, and defects of every nature which unfit them for the use for which they are intended. No plugging or filling will be allowed.

Specimen bars of the metal used, each being 26 in. long by 2 in. wide and 1 in. thick, must be made without charge as often as the engineer may direct, and in default of definite instructions, the manufacturer must make and test at least one bar from each heat or run of metal. The bars when placed flatwise upon supports 24 in. apart, and loaded in the center, must support a load of 2200 lb., and show a deflection of not less than 0.35 in. before breaking; or if preferred, tensile bars may be made which must show a breaking point of not less than 22,000 lb. per sq.in., bars to be cast as nearly as possible to the dimensions without finishing, but corrections may be made by the engineer for variations in width and thickness, and the corrected result must conform to the requirements.

[(b) All wrought iron or mild steel used must be of the best quality of refined iron, of a tensile strength of at least 45,000 lb. per sq.in.]*

(c) All composition or other noncorrodible metal used must be of the best quality, to have a tensile strength of not less than 32,000 lb. per sq.in., with 5 per cent. elongation in eight diameters and 5 per cent. reduction of area at breaking point. Composition for inside hose valve stems must have a tensile strength of not less than 55,000 lb. per sq.in. and an elastic limit of not less than one-half the tensile strength.

5. HOSE VALVES AND NIPPLES.

(a) Hydrants must have at least two hose connections.

(b) If hose gate valves are used they must be of the outside detachable type or be built inside the barrel. The outside hose gate valves must be made of composition or of iron with composition trimmings, with lugs cast on the valve body, and each valve must be bolted to the hydrant by two ¾-in. tap bolts, spaced horizontally 5⅝ in. on centers. The valves must not project further than necessary, and must be of the inside screw type, placed in a vertical position, with the handwheel at least 3 in. below the base of the operating nut.

Inside hose-gate valves must have composition metal working parts and be of rugged design, and must introduce an unnecessary friction loss. There must be ample clearance between the gate and the hydrant body when the gate is in any position. The gate and parts should be interchangeable, and the valves should be located so as to be as accessible as possible for repairs. The gate must be designed so that it cannot come off in use. The top of the stem must be below the level of the hydrant-stem nut, so that the hydrant wrench can be freely operated.

(c) Hose nipples must be of composition metal threaded with a fine thread into the hydrant, and securely pinned in place or carefully locked and calked in place. If desired, the nipple may be cast with two side lugs and be bolted to the hydrant.

(d) Hose threads on all hydrants to be installed in any given district must of necessity be interchangeable with those already in service, but, where practicable, threads should conform to the National Standard. The essential features of the "National Standard" thread in the 2½-in. size are a 60° V-thread, outside diameter on male threads of 3 1/16 in. and 7½ threads per inch.

(e) The stems of the hose valves must be not less than ¾ in. in diameter for the 2½-in. valves, and not less than ⅞ in. in diameter for the valves at the steamer connections.

(f) The stem nut of all inside hose and steamer connection gate valves must be ½ in. square.

6. HYDRANT VALVE.

(a) The valve seat must be made of composition metal securely fastened in place.

(b) The valve must be faced with a yielding material, such as rubber or leather, except that if of the gate type, a bronze ring may be used. The valve must be designed so that it can be easily removed for repairs without digging up the hydrant.

(c) The clearance of parts must be such that corrosion will not make the parts inoperative.

7. DRIP VALVE.

(a) A positively operating non-corrodible drip valve must be provided and arranged so as to drain the hydrant when the main valve is shut.

(b) The seat of the drip valve must be made of non-corrodible metal and must be securely fastened in the hydrant. All other parts of the drip mechanism must be designed to be easily removed without digging up the hydrant.

8 OPERATING STEM.

*Referred back to Committee for reconsideration.

*Referred back to Committee for action on allowable strength of steel.

(a) The threaded section of the operating stem when located in the waterway must be of composition or other non-corrodible metal, but when above the stuffing-box it may be of wrought iron or steel.* The operating stem where it passes through the stuffing-box and gland, must be of composition metal or be fitted with a composition-metal covering. [The diameter of the operating stem at base of thread must be not less than 1⅛ in. for gate type of hydrant and 1 in. for compression and toggle types. The remainder of stem may be of iron and the diameter must be not less than 1⅜ in. for gate type of hydrant and 1¼ in. for compression and toggle types. The operating stem must be attached, so that in operation it will be impossible for it to become detached.]†

(b) The stem must terminate at the top in a nut of pentagonal shape, finished with slight taper to 1½ in. from point to flat, except for hydrants to be installed where existing hydrants have different shape or size of nut, in which case the additional hydrant must have the same operating nut as the old ones for uniformity. The nut socket in the wrench must be made without taper so as to be reversible.

(c) The thread which operates the valve must be Acme, half V or square.

9. STUFFING-BOX OR GLAND.

(a) The stuffing-box and gland must be of composition metal or bushed with it. If a packing nut is used, it must be of composition metal. The bottom of the box and end of the gland or packing nut must be slightly beveled.

(b) Gland bolts or studs must be of composition metal, wrought iron, or steel, at least ½ in. in diameter. The nuts must always be of composition metal.

10. HYDRANT TOP.

(a) The hydrant top must be designed so as to make the hydrant as weatherproof as possible, and thus overcome the danger of water getting in and freezing around the stem. Provision must be made for oiling both for lubrication and to prevent corrosion. A reasonably tight fit should be made around stems.

(b) There must be cast on the hydrant top, in characters raised ⅛ in., an arrow at least 2½ in. long, showing direction to open, and the word "OPEN" in letters ¾ in. high.

11. HOSE CAPS.

(a) Hose caps must be provided for all hose outlets, and must be securely chained to the barrel with a welded chain of wire, not less than ⅛ in. in diameter.

(b) The hose cap nut must be of the same size and shape as the operating nut.

(c) A leather or rubber washer or, if requested, a lead washer or disk must be provided in the hose cap, set in a groove to prevent its falling out when the cap is removed.

12. MARKING.

(a) Hydrants must be marked with the name or trademark of the manufacturer and the year of manufacture. All letters and figures must be cast on the hydrant well above the ground line. They must be 1 in. high and raised ⅛ in. on the casting, except the date mark which may be abbreviated and be smaller if legible.

13. TESTING.

(a) Hydrants, after being assembled, must be tested to at least 300 lb. per sq.in. before leaving the factory. If the working pressure is over 150 lb. per sq.in. the hydrants must be tested to twice the working pressure. The test should be made with the valve open in order to test the whole barrel for porosity and strength of hydrant body. A second test should be made with the valve shut in order to test the strength and tightness of the valve.

(b) Hydrants must be fully opened and closed before shipping in order to test the freedom and strength of the parts. The conditions of the test should be made as severe as are liable to occur in service when using a hydrant wrench at least 17 in. long.

14. DIRECTION TO OPEN.

(a) All hydrants must open to the left (counter-clockwise), except where existing hydrants open to the right, in which case additional hydrants should turn the same as the old ones for the sake of uniformity.

H. O. LACOUNT, Chairman,
GEORGE A. STACY,
FRANK A. McINNES,
FRED W. GOW,
WILLIAM F. SULLIVAN,
Committee.

*Note—The iron-threaded section is permissible only where the hydrants are to receive the best of care and be kept oiled, otherwise composition must be used to insure reliable operation.

†Referred back to Committee for consideration of stem sizes since 4-in. hydrant is now included.

Los Angeles Power Bond Election on May 8

By Burt A. Heinly*

Los Angeles, Calif., on May 8, will vote for the second time upon the proposal to issue bonds to the amount of $6,500,000 for the partial development and distribution of electric power as manufactured from the power drops of the Los Angeles Aqueduct.

The Los Angeles Gas & Electric Corporation, the Edison Electric Co. and the Pacific Light & Power Co., comprising the three great electric corporations of Southern California, and controlling the power field in this part of the State, have united to defeat the plans of the City. The Chamber of Commerce and the Municipal League, the two most important civic organizations, with a number of other civic societies of lesser strength, have united to fight for the passage of the bonds.

In April of 1913 the same proposal as is now before the people received a vote of 30,615 for and 20,800 against, failing of passage in that the vote was not a two-thirds majority vote as is required by the charter

In the present instance, both sides realize clearly that it is a life and death struggle with the outcome for the passage of the bonds very much in doubt. If the bonds fail of passage, it is hardly probable that the question will be again submitted for several years, in which interval the power companies will have additional opportunity for their further general entrenchment and for placing their conduits in the streets, which already contain many conduits of the public-utility servers.

The outcome to the lighting corporations throughout the State and country is held to be of grave import and private interests are spending money lavishly in every form of publicity. With their five thousand employees, the three companies, united under a single head for the fight, are carrying on a house-to-house campaign. The City is hampered, as is always the case, by the fact that it must rely upon contributions from public-spirited citizens to carry on its work of education. Three of the six newspapers, and Los Angeles is a "newspaper town," have lined up for the bonds. The *Times* of Harrison Gray Otis is in open opposition and the Hearst morning and evening papers, while seeking to show an apparent nonpartisanship, are doing as little as possible to bring out a favorable vote. It is to be one of the most bitter campaigns ever waged and in which much personal animosity is being engendered, as is shown by suits for damages filed April 18 by E. T. Earl, owner of the Earl papers, against the *Times*, *Examiner* and *Herald* to the amount of $265,000, this amount being claimed on account of alleged libelous statements concerning Mr. Earl and the power bond issue.

The issues are clouded, giving occasion for both sides to claim misrepresentation and unfair tactics. In the campaign of a year ago, the power companies in their newspaper advertising statements urged that the city, before calling a bond election, should have met them halfway on some proposition by which their distribution systems might have been leased. Their main argument was that it was uneconomical and inadvisable to build a fourth distribution system.

*645 South Olive St., Los Angeles, Calif. The author is connected with the Los Angeles Aqueduct but the statements which he makes are, of course, unofficial.—Ed.

Upon the failure of the bonds to carry, the city did enter upon such negotiations as the companies had urged. After a number of meetings and the submittal of proposals and counter-proposals from both sides, the city's representatives finally brought the deliberations to a conclusion with the proposal that the companies should lease their distribution systems to the city for five years, the city to operate, maintain and extend the distribution systems; the rental to be fixed by the State Railway Commission; the city at the end of the five years to take over the systems, if the consent of their trustees could be procured, at a valuation which also was to be determined by the State Railway Commission. After several delays, the companies refused to accept this proposal on the plea that their trustees could not legally bring about such a sale, clauses in their trust deeds making it prohibitive.

When negotiations were broken off, the city council, by a unanimous vote, ordered that the bond election should be held. The city stands in this position: It has a power plant, power tunnels, penstocks, and other power accessories in San Francisco Cañon on the first power drop of the Aqueduct, 47 miles from the city, where it has made an investment of $3,500,000. This plant, with a peak load capacity of 37,500 hp. and an average horsepower of 16,000 lacks about six months of completion. Funds for carrying on the work have been exhausted. To complete the plant, erect transmission lines and establish a substation in a favorable location within the city will require an estimated expenditure of $1,250,000. The remainder of the issue it is proposed to spend on a distribution system. The city council has passed resolutions that if the bonds carry, a new distributing system will not be built but that condemnation proceedings for such properties of the private corporations as are required will be immediately started. If the bonds fail to carry, the city's power properties must lie idle until such time as the people are of a mind to vote money for their completion and productivity.

The power companies claim that the city council should have divided the issue into $1,250,000 and $5,250,000, permitting the people themselves to determine whether they desire to municipally distribute the power or sell wholesale to the companies for distribution; that city officials were afraid to give the people free choice in this and that the council's action in power matters has been governed by the political aspirations of several of its members. It is further alleged that the provisions of the recently proposed contract, already set forth, were purposely made so onerous that the only alternative of the power companies was a refusal. The answer the city makes to this is that the power companies, as is usually the case, have issued stocks and bonds based not on the real value of their properties but on a capitalization of their *earning* capacity; that the trustees can legally sell the properties entrusted to their care but have taken refuge under legal technicalities for the reason that the appraisal of the properties by the State Railway Commission would not be sufficient to meet the face value of their securities.

Had the issues been divided as demanded by the power companies, there is no doubt but that they would not openly have fought the passage of the smaller amount but would have turned their energies to the defeat of the larger.

In refuting this argument for division of the issue, city officials claim that no partition of the issue is economically possible, for it is as necessary to provide for some means of distribution as it is to provide for the completion of the generating and transmission system, and that until the city has actual money behind it, it can hope for no favorable outcome with the power companies in any negotiations that may be undertaken. They point to a period of two years in which every attempt has been made by the city to come to some understanding with the corporations. It is pointed out, also, that early in the history of the Aqueduct project, the citizens were fearful that when the undertaking was completed and ready for operation the fruits of the vast undertaking might be turned over, by an evil administration, to vested interests. To prevent this, the people, by popular vote, placed in the charter of the city the provision that no Aqueduct water or power should *ever be sold to a private corporation for redistribution* without a two-thirds vote of consent on the part of the electorate. It is a fair statement to make, that few cities, and Los Angeles perhaps least of all through the great municipal enterprises that she has and is carrying on, in this period would consent to turn over to a private company any phase of a public utility. Therefore, it may be stated that the argument of any partnership with the power corporations is not a strong one.

So the situation stands in Los Angeles today. The battle being waged is one within a community. From this standpoint it is strictly a local one. However, the results are not confined to Los Angeles limits. The Aqueduct project truly stands as one of the most notable municipal economic achievements of history. If the city determines by the vote of May 3 that it shall not complete one of the most important phases of the work, the hydro-electric trust will be given a firmer grasp on California, and in the nation at large the experience of Los Angeles can be interpreted only as an example of the impracticability of municipal enterprise.

Proposed Code of Ethics of the American Society of Civil Engineers

At the business meeting of the American Society of Civil Engineers to be held in connection with the annual convention at Baltimore, Md., June 2, 1914, the following code of ethics will be submitted for action by the membership. The Board of Direction of the society recommends its adoption.

It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:

(1) To act for his clients in professional matters otherwise than as a faithful agent or trustee, or to accept any remuneration other than his stated charges for services rendered his clients.

(2) To attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects, or business, of another Engineer.

(3) To attempt to supplant another Engineer after definite steps have been taken toward his employment.

(4) To compete with another Engineer for employment on the basis of professional charges, by reducing his usual charges and in this manner attempting to underbid after being informed of the charges named by another.

(5) To review the work of another Engineer for the same client, except with the knowledge or consent of such Engineer, or unless the connection of such Engineer with the work has been terminated.

(6) To advertise in self-laudatory language, or in any other manner derogatory to the dignity of the profession.

The East River Tunnels of the New Rapid Transit Lines in New York

The Public Service Commission of the First District of the State of New York, which is charged as part of its duty with the construction of the new rapid transit lines in Greater New York, has just asked for tenders to be made not later than May 22 next, for the two pairs of tunnels which will run under the East River and will form connections between the lower part of Manhattan and the Borough of Brooklyn.

The more southerly pair of tubes, running from Whitehall St., Manhattan, to the foot of Montague St., Brooklyn, form part of a route which is to be eventually operated by the Brooklyn Rapid Transit Railway Co. The other pair, located approximately 1300 ft. farther north, run from Old Slip, Manhattan, to the foot of Clark St., Brooklyn, and will be operated by the Interborough Rapid Transit Co. The length of the cast-iron tubes between shafts is approximately 4090 ft. for the southerly pair, and 3799 ft. for the northerly pair.

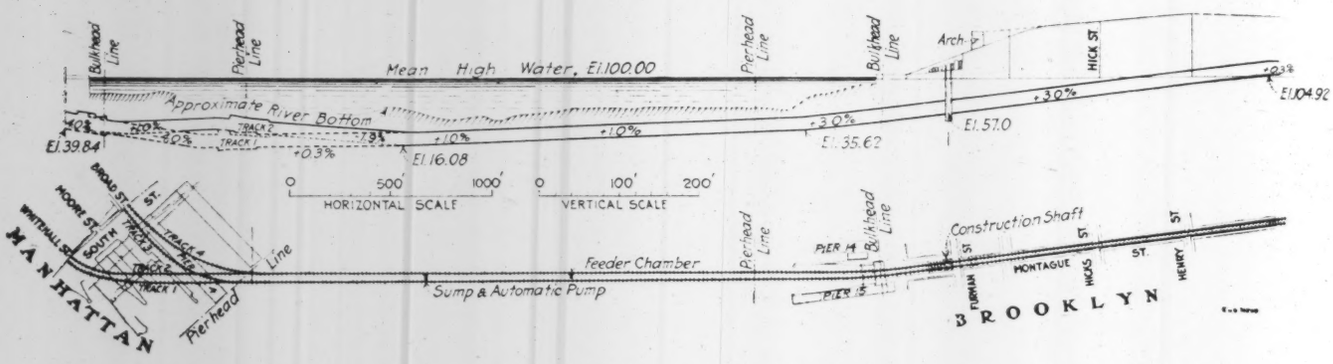


FIG. 1. PLAN AND PROFILE OF WHITEHALL ST.-MONTAGUE ST. TUNNEL UNDER EAST RIVER, NEW YORK CITY

The official designation of this part of the rapid transit system now under construction is for the southerly pair, Section No. 2 of Route 33, and Section No. 3 of Route 48 for the northerly pair.

The specifications require that the tunnels shall be built by the shield method using compressed air, and of cast-iron segments bolted together and lined with concrete. A plan and profile of the southerly crossing, that is the Whitehall-Montague tunnel, together with a cross-section of the tunnel and a detail of the lining are shown in the accompanying drawings. The shafts are steel caissons sunk to the required depth and with openings formed in the sides through which the shields may be started.

There are to be two separate contracts, one for each pair of tubes, but they are so arranged that for both contracts, prices may be named, (a) for the work proposed in either one alone without dependence upon the award of the other, or (b) for the work proposed in case the award should be made for the work under the second also.

The two pairs of tunnels are quite close together; a plot of land (16,000 sq.ft.) has been acquired for a plant at each end, it being required that each plot shall serve for both tunnels. If the award is made to a different contractor for each pair, each contractor is to have the use of half of each plot, but it is thought that lower prices may be bid by contractors on the condition that they are awarded the whole work, as then only one plant would be required at each end, and, of course, the overhead charge should be less per unit.

The provisions for the supervision and conduct of the work in compressed air are based on the considerably increased knowledge of the state of the art which has been developed by the large amount of this type of construction which has been carried out in and around New York in recent years, during which there have been built six tunnels under the North River and six under the East River, besides the gas and water-works tunnels.

The air-compressing plant is required to be capable of furnishing simultaneously to each heading an air supply of 10,000 cu.ft. of free air per min. at 45 lb. (above atmospheric) or if one plant is used for all the headings on one side, of 8000 cu.ft. to each heading. It is required that complete continuous records of plant performance be kept.

It is required that sufficient air shall be provided at all times and places to prevent the accumulation of carbon dioxide to a greater amount than one part in a thousand, and that a foul-air pipe 6 in. in diameter shall be carried back from each heading under pressure to the ordinary atmosphere, with, of course, a suitable regulating valve.

It is required that a qualified physician and surgeon shall always be on duty on the work, that a suitable hospital room and hospital lock be provided at each end and that no person shall be allowed to work in compressed air unless he has been examined by the physician and pronounced fit.

It is required that at least two separate air chambers (that is, there must be an intermediate bulkhead) shall be in use when the air pressure exceeds 22 lb., except where higher pressure is required in starting. The distance from the heading to the nearest bulkhead is never to exceed 800 ft. Safety screens are to be provided in the upper half so that there will always be one within 15 ft. of the rear end of the shield. These are to be of steel plate and of a form to be easily moved ahead as the work progresses.

Three locks are to be built in each bulkhead, two main locks and an emergency, the latter to be located as high up as practical, to be capable of holding an entire heading shift, and to be connected with the shield platform by a proper runway.

From the brief outline of the salient points of the provisions governing the conduct of the work in compressed air, it will be seen that if the work is carried out in the

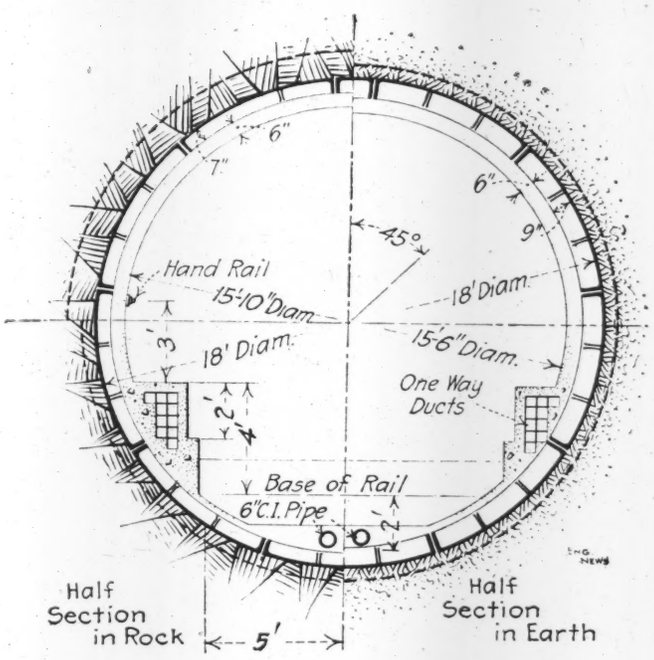


FIG. 2. TYPICAL SECTION THROUGH WHITEHALL-MONTAGUE TUNNEL

spirit of the specifications any possibility of danger is reduced to a minimum, as is also the liability to sickness or loss of life due to the work in compressed air.

The cast-iron lining is to have recess joints for calking, and it is required that this lining be made water-tight by calking the joints with lead and the bolts made tight with grummets. Tests for water-tightness will be made by lowering the air pressure.

Provision is made for grouting outside the tunnel, and of any voids between the concrete lining and the cast-iron segments.

Some of the principal items of work to be done under these two contracts are as follows:

	Northerly tunnels	Southerly tunnels
Tunnel excavation below mean high water in earth, cu.yd.	69,000	68,000
Tunnel excavation wholly in rock, cu.yd.	11,150	79,300
Tunnel excavation partly in earth and partly in rock, cu.yd.	21,300	6,300
Concrete in free air, cu.yd.	33,000	39,000
Concrete in compressed air, cu.yd.	2,200	3,850
Grout, bbl. portland cement	60,000	20,000
Grout, bbl. natural cement		42,000
Cast-iron tunnel lining, tons	36,150	37,200
Steel bolts and nuts, tons	1,570	1,300

Tunneling through High Railway Embankments, to provide additional drainage opening, is proposed on a railway having a considerable extent of side-hill line where the drainage toward the river is obstructed by the embankments. The present method is to make a crosscut or trench at each point, put in a pipe drain and fill around it with rock. This involves cuts 40 to 50 ft. deep, and it is thought that better results could be obtained in driving small tunnels through or under the banks, especially if a simple shield could be devised for tunnel work of this character.

The Abandonment of Macadam As a Road Pavement is recommended by William Elbring, Highway Engineer of St. Louis County, Mo., according to newspaper versions of his recent annual report. Mr. Elbring states that rapidly increasing traffic has made various forms of macadam road construction inadequate and urges the construction of permanent pavements of brick or concrete costing from $15,000 to $20,000 per mile. The report shows that $372,161 was expended on maintenance during the past year, an increase of nearly $12,000 over the previous year.

Municipal Port Improvement Project, Jacksonville, Fla.

Broad powers to acquire, construct, equip and operate municipal docks and railway terminals were granted to a Board of Port Commissioners of Jacksonville, Fla., by a special session of the legislature the latter part of 1912. On Jan. 21, 1913, a $1,500,000 issue of 4½%, 30-year bonds, authorized by the legislature, was approved by popular vote. Bids for these bonds are to be received on May 20, 1914.

Physical data for the design of the docks have been secured but the site has not been chosen. The delay has been in part due to litigation over the bonds, and the validity of the bonds has recently been established by the State Supreme Court.

The Board of Port Commissioners consists of 15 members, elected by popular vote for terms of four years at nominal salaries of $100 a year. Anyone nominated by 50 petitioners becomes a candidate. W. P. Corbett is Chairman and P. D. Cassidey is Secretary of the Commissioners, the latter also being a member of the Board. Some months ago, the Board appointed F. W. Bruce as Engineer, Mr. Bruce resigning from the local office of the Engineer Corps, U. S. A., to accept the position.

The Board has supreme control of all the affairs under its jurisdiction, except that it cannot lease any part of its property for use for a term exceeding ten years without ordinance approval by the mayor and council. No lease shall exceed twenty years and no lease shall be made which "will interfere with the furnishing by the Port Commissioners of ample dock and terminal facilities as municipal docks and terminals open to all on reasonable terms."

The majority of the Commissioners favor what is known as the "Soldiers Home Site" or "City Limit Site," a tract of land on the St. John's River bisected by the city line, and located within about a mile of the point from which all incoming railroads and branches of railroads diverge for the distribution of freight. From this diverging point the railroads run to the water front, touching it not far from either end of the site proposed by the majority. Only a little rock excavation would be required here.

The minority favor what is known as the "Commodore Point Site." This is considerably nearer the center of the city, but has the disadvantages of difficult right-of-way access and of much rock excavation. The estimated cost of the latter is $800,000.

The majority site project is the one recommended by the Engineer to the Commission and his plans have recently been approved by J. F. Coleman, of New Orleans, the engineer who devised and executed the public-dock facilities of that city.

The majority site scheme would provide ultimately for the simultaneous accommodation of 16 ships. At the outset, eight piers are proposed, most of which would be 600 ft. long and 300 ft. wide. All the slips would have a water depth of 30 ft., which is the depth now being provided from Jacksonville to the Atlantic Ocean by the Federal Government (24-ft. depth dredged all the way and 30 ft. much of the way).

Mr. Bruce's plans provide for piers at an angle of 60° with the bulkhead line; for solid piers with apron docks about 40 ft. wide; and for railway connections, with tracks on each pier and cranes for handling freight.

National Drainage Congress

The fourth annual National Drainage Congress was held at Savannah, Ga., Apr. 22-24. There were presented a number of papers of a popular or semi-popular character on the engineering and sanitary phases of drainage. In addition, there were a number of addresses, the animating spirit of which was to secure support for the bills now before the Congress of the United States (Clark bill in the House—H. R. 8189—and Williams bill in the Senate) providing for a federal "flood protection and drainage fund," and for the federal construction of flood protection and drainage works to promote the general welfare, prevent the spread of malaria among the several States, and "to promote interstate commerce by navigation." Resolutions supporting these bills, which were really drawn in behalf of the officers of the Drainage Congress and are being promoted by them, and urging measures for the study and prevention of malaria, were adopted by the convention.

Address of Sir William Willcocks

In point of general interest, the one great feature of the meeting was an illustrated address on "River Regulation and Control in Antiquity," by Sir William Willcocks, of Cairo, Egypt, who came to this country to deliver the address, and has since been invited to appear at a Congressional committee hearing on the drainage bill. Mr. Willcocks gave an interesting talk on the ancient control of the Euphrates, the Tigris and the Nile for purposes of irrigation.

The banks or levees constructed to control the Euphrates were 100 ft. wide and had no break in a period of 3000 years. In the seventh century, a serious break in the banks of the Tigris led to the summary execution of four hundred engineers and supervisors on the spot.

When the Nile reaches the danger level every male Egyptian between the ages of 20 and 60 is subject to call. Men are stationed at frequent intervals along the banks, and boats loaded with stone are dotted along the river. The banks and waters are lighted at night during the flood period, making an animated and beautiful scene. Immediately a slight breach occurs, naked men form a close line across it, a rope is stretched and brush and stone placed. Meanwhile, the wives of the men gather and pray for the safety of husbands and country.

The fewness of the breaches in the banks of the Nile are due to the highly centralized measures of prevention in force and the response as one man of all the people to avert damage—from which American districts subject to flood might learn a lesson, the speaker said.

From the works of antiquity as a whole, moderns may learn the value of thoroughness, combination and continuity. More specificaliy, the value of wide banks for river control is shown, as well as the value of an old bank—for an established bank is one of the greatest of assets and should be maintained regardless of expense, since new banks are a constant source of trouble.

Other Engineering Addresses

"Some Important Features in the Present Drainage Situation" was the subject of a paper by C. G. Elliott, of Washington, D. C. Drainage district bonds are now a banking commodity and a good investment, Mr. Elliott declared, and he added that he had never known a drainage district to default on its bonds.

Education, both general and to provide drainage engineers, is a need of the day. Nearly every State has a drainage law on its statute books and most of these laws are workable, although some of the newer ones need amendment.

Some of our present drainage conditions can be met only by the strong arm of the Federal government, extending where the states cannot reach. This is particularly true as regards lands in the drainage area of interstate streams. Financial aid from the Federal government is also needed.

Some remarks on "Fundamental Factors in Drainage" were made by N. C. Grover, Chief Hydraulic Engineer, U. S. Reclamation Service. Papers dealing with drainage and river control in various states were presented as follows: "Flood Regulation in California," by A. L. Colwell, of the River Regulation Commission, Stockton, Calif.; "Drainage Work in North Carolina," by Joseph H. Pratt, State Geologist and Engineer; "Drainage Reclamation in Georgia," by J. V. Phillips, U. S. Drainage Engineer in charge, Savannah; "Drainage Activities in South Carolina, by F. G. Eason, U. S. Drainage Engineer, Charleston.

A number of papers on malarial reduction were presented by members of the U. S. Public Health Service and others. The commanding importance of drainage in mosquito and malaria reduction was shown.

General Business

The leading officers elected for 1914-15 were: President, E. J. Watson, Commissioner of Agriculture for South Carolina, Columbia, S. C.; First Vice President F. B. Knight, Lidgerwood Mfg. Co., Chicago, Ill.; Treasurer, A. L. McLaughlin, Washington, D. C. Edmund T. Perkins, of Chicago, was given the title of Honorable Past President, and Sir William Willcocks was made Honorary Vice-President at Large.

The next regular meeting place will be Washington, D. C., the date to be selected later. It is proposed to hold an international Drainage and Flood Prevention Conference during the Panama-Pacific Exposition in 1915.

The treasurer's report showed receipts and expenditures of about $8000 during the past year, with a small balance on hand.

A Government Concession to a Cement Company is to be made in India. The plant in question is to be built on government land at Dandot in the district of Jhelum in the Punjab by a private company known as the Punjab Cement Co. The proposition which the government is about to accede to is that the Indian government agree to take the whole output of the company up to 150,000 bbl. per year at a price of $2.50 per bbl., and any quantity over that at a price of $1.75 per bbl. up to the amount required by the government. In return the government will undertake to purchase cement only from the company during the period in question and not to grant any concession to any other person, firm, syndicate or company for the manufacture of portland cement. This does not debar a competing firm from putting up works on land which does not belong to the government, as this can be done without any concession; there is small chance of any such enterprise being undertaken since the government is likely to be the principal user of cement, so that the concession grants practically a monopoly to the cement company at least in the Punjab district, which is a large part of India. There are three other cement plants in the whole area of India, but they are insufficient to supply the growing need for the material in that country.

Emil Gerber

In a strange coincidence there occurred the deaths within four days of each other, of two engineers, both of whom achieved distinction as right-hand assistants of the late George S. Morison, one of the most famous of American bridge engineers and the instructor and inspirer of many other engineers. One of these engineers was Alfred Noble and the other Emil Gerber, whose deaths were noted in our issue of last week. A biographical sketch of the latter was given on p. 938.

Mr. Gerber's first important experience in bridge construction was under Morison on the Blair Bridge over the Missouri River, in 1885-'86. In 1889, he took charge of Mr. Morison's downtown office in Chicago. In the next eight years, he was in charge of erection of many of Morison's notable bridges. Mr. Gerber left Mr. Morison in 1897 to become Chief Engineer and afterward Manager of the Lassig Bridge & Iron Works, Chicago, and was with this company until it was absorbed by the American Bridge Co. in 1900.

An engineer who was associated with both Alfred Noble and Emil Gerber, under Mr. Morison, and who for the past 14 years has been an associate of Mr. Gerber on the staff of the American Bridge Co., O. E. Hovey, Assistant Chief Engineer, writes of Mr. Gerber as follows:

"As one who has been associated with the late Emil Gerber almost constantly during a period of about 24 years, it seems that something should be added to the brief obituary notice which appeared in the ENGINEERING NEWS of Apr. 23.

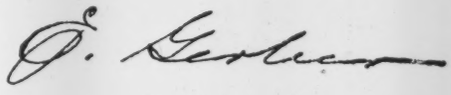
"It frequently happens that an engineer employed by individuals or corporations does not become so well and favorably known as he would have had he been in practice under his own name. It is also a common occurrence for an engineer associated with corporations to specialize along some narrow line of engineering work. Mr. Gerber was an exception in these respects. His early experience covered a very wide range of work including railroads, difficult foundations, construction of bridges and other structures pertaining to railroads, and at the time he took up his work as an engineer associated with a corporation, his experience was wide and his judgment well trained.

"In the writer's earliest association with Mr. Gerber, during a period when our relations were extremely close, his strongest impression of Mr. Gerber's personality and character was the thorough manner in which he carried out any work on which he was engaged, and his genial and helpful disposition, and his hearty and liberal endeavors to assist those around him in every way. He was a man who would ungrudgingly draw from his own experience anything that would help his associates to grasp an engineering situation with which he had been familiar.

"He never did anything superficially. Any problem that was before him received his complete and earnest attention. Another engineer who has been closely associated with him for a long period commented to the writer, that whenever Mr. Gerber undertook an investigation or made a report he could reply on his having investigated the matter with great thoroughness, his having expressed his best opinion concerning the matter in question and on the absolute reliability of any facts contributed to the subject by him.

"He had a strong mentality and firm opinions on any subject to which he had given thought, but at the same time was always ready to discuss exhaustively the opinions of others and when they were backed by facts and good reasoning, was ready to modify his previous views in an eminently fair minded manner.

"A notable trait of his personality was the unusually cordial relations which he established with those with whom he was immediately associated and his personal interest in all that contributed to their welfare. One of his



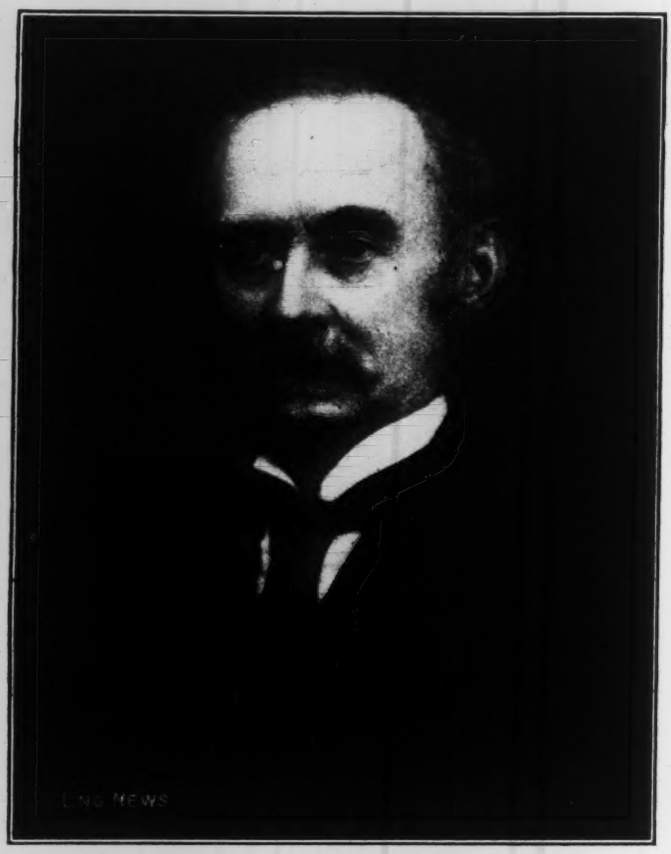
close associates makes the comment, that 'he had a magnetic fervor which induced me to confide my troubles to him. He never asked for this confidence, but I simply had to give it.'

"On account of Mr. Gerber's connection with a multitude of engineering works, to which he contributed in more or less degree, and in which his strong common sense and clear thinking determined important decisions concerning designs and methods of construction, it is unfortunate that the profession cannot point definitely to this or that work as purely his own. His monument is a more personal one. His strong, honest, thorough and genial personality has impressed itself on all who knew him and most on those who knew him intimately. We feel a personal loss. He was our friend in the best sense of that word so full of meaning. Such characters are an inspiration to all members of the profession."

Thomas H. Johnson

We present herewith a portrait of the late Thomas Humrickhouse Johnson, M. Am. Soc. C. E., Consulting Engineer of the Pennsylvania Lines west of Pittsburgh, a brief biographical sketch of whom appeared on p. 938, of our issue of Apr. 23.

Mr. Johnson will be remembered by the older members of the profession as a pioneer structural engineer and particularly as an investigator of the theory of column design. He was a contributor to the early volumes of the *Transactions* of the American Society of Civil Engineers, and was the author of the paper, "On the Strength of Columns: Discussing the Experiments Which Have Been Accumulated, and Proposing New Formulas," read at the annual convention in 1885, in which was first proposed the now famous "straight-line" column formula.



THOMAS H. JOHNSON

Notes from Engineering Schools

UNIVERSITY OF MONTANA—A State School of Forestry has been established in connection with the University and at Missoula, in accordance with an act of the thirteenth legislative assembly. A four-year course will be offered here for the professional training of men in the management and utilization of Western forests. This work is quite distinct from the work which has been offered at the University during the past five years, which consisted largely in a few studies of botanical aspects. The courses prescribed will follow largely the recommendations of prominent lumbermen and the administrative officers of the national forests in the West. Particular attention will be paid to the consideration of Western forest types and Western problems. The conditions are considered very favorable for the rapid development of this work here.

NEWS NOTES

A Hotel Gas Plant Explosion killed eight persons and injured nine others, in the Macoun Hotel, at Macoun, Sask., on Apr. 20.

A Broken Water Main in Colville, Wash., flooded cellars, washed out streets, and caused the city water supply to be stopped for the day, on Apr. 17.

A Falling Derrick killed one man and seriously injured another in the employ of Brewer & Jones, contractors, of Birmingham, Ga., on Apr. 25, near Rome, Ga. Press dispatches blame rotten timbers for the collapse.

Highway Accidents in the British Isles have increased greatly since the extensive introduction of mechanically propelled vehicles. The persons thus killed there in 1913 numbered 2099; while 42,544 were injured. This is an approximate average of six killed and 122 injured per day.

A Column Fell from the Second Story during the demolition of the old building formerly occupied by the Chicago Foundry Co., Chicago, on Apr. 23. When a portion of a wall collapsed, the column fell through the flooring of the second story, carrying with it three workmen. One was badly injured.

Two Large Fertilizer Plants Burned on Apr. 26, at Curtis Bay, near Baltimore, Md. One, the Atlantic Fertilizer Co., is controlled by Amour & Co.; the other, the United States Fertilizer Co., by Sulzberger & Co. Press dispatches state that officials of the concern estimate the total damage at $1,350,000.

Municipal Port Improvements at Pensacola, Fla., are projected. The city has voted $500,000 bonds for the work and will probably ask bids for the bonds soon. It is likely that the work will be carried out under the direction of the City Council. A. Greenhut is Mayor and L. E. Thornton is City Engineer of Pensacola.

Side-Pusher Electric Locomotives are used on the Cleveland ore docks of the Pennsylvania R.R. They do not run on the same tracks as the cars they move, but on parallel 42-in. gage tracks at one side. Each carries a triangular side-arm frame on trunnions and this is raised to clear or lowered to engage the corner or pole plates. Energy is taken from two protected rails lying inside the running rails.

Two Complete Fish-Canning Factories Were Shipped to Kamchatka, a peninsula of the Siberian Coast, by the W. E. Bliss Co., Brooklyn, N. Y. The expedition is scheduled to arrive at its destination in the early part of May. The plants are for the manufacture of tin cans and for the filling of these cans with salmon. On account of dangerous reefs the machinery will have to be landed in small boats. It is expected that the plants will be in operation by June 1, in time for the salmon season, which starts about the middle of July.

Bituminous-Surfaced Concrete Pavements at Jacksonville, Fla., will be laid this year to a considerable extent. A 5-in. course of 1:2:4 concrete will be sprinkled with oil at the rate of ⅓ gal. per sq.yd. of pavement and then covered with screenings. Expansion joints will be laid parallel to the curbs and also 50 ft. c. to c. The contract price is $1.25 per sq.yd. and the contractor is the Wilson Construction Co., Jacksonville, Fla.

The Chief Engineer of Savannah, Ga., under a city ordinance passed on Mar. 5, 1913, performs the duties previously fulfilled by the Director of Public Works and the City Engineer. He is Purchasing Agent of the city and has full control of the execution of all work to be done in the streets, lanes and roads; all [land] drainage work, sidewalks, curbing, bridges and culverts; cleaning, sprinkling and lighting of streets, except where under the Park and Tree Commission; scavenging; docks and slips; city buildings, except water-works, police and fire, and makes all surveys for public works and gives grades and building lines. E. R. Conant became Chief Engineer on Apr. 1, 1913.

The 3-c. Rate for Electricity, adopted by the Cleveland, Ohio, City Council, on Mar. 16, for its municipal central supply works has been protested by the Cleveland Electric Illuminating Co. (competing). The company claims that the

tion of the city in soliciting business in equity disbars it from fixing the terms of competitive business. The rate, it is contended, was fixed without investigation; no data are available from the operation of the new $2,500,000 plant nearing completion and experience with the smaller plants in the Brooklyn and Collingwood sections, it is claimed, does not warrant 3c. per kw.-hr. for residence-lighting energy as proposed.

German Machinery Imports and Exports for 1913—Machinery importations into Germany from all nations, during 1913, amounted to about 100,000 tons distributed as follows: United States, 40%; Great Britain, 34%; Switzerland, 6%; Canada, 7%; Belgium, 2%; Austria Hungary, 1.6%, according to the German Association of Machine Builders (quoted in the "Bulletin" of the American Association of Commerce and Trade, of Berlin). Among the different classes of machines imported and their percentages of the total were the following: Agricultural machines, 38,535 tons, 44%; tool machines, 7539, 8.5%; cranes, 2153, 2.5%; steam boilers, 1476 tons; railway and street cars, 6292 tons; motor vehicles, 2261 tons.

The Peace Creek Drainage District, Florida, was recently organized under a state drainage law of 1913 and surveys are now being made. Preliminary estimates by C. G. Elliott, Consulting Engineer, Washington, D. C., indicate that 40,000 acres can be drained at a cost of about $225,000. Final plans have not yet been presented and approved nor have bonds been voted. It is expected that the main canals will be dug by ordinary floating dredges and that open laterals one-fourth mile apart will be dug by ditching machines. The district was formed by a vote of the land owners and its affairs are managed by three trustees, of whom E. L. Mack, Bartow, Fla., is secretary.

Results of a Profit-Sharing Plan, put into operation at the beginning of 1913, have been announced by the Clipper Belt Lacer Co., Grand Rapids, Mich. The plan actually used had been tried out with success the year before in one department. The scheme is very simple—the factory has been put on piecework basis with an agreement never to lower the piece rate; at the end of each year all employees who have been with the company one year or less receive 5% of their annual wages, this percentage rising 1% for each year of service up to a maximum rate of 10%. The plan is contingent on sufficient profits of the concern. At the end of 1913 it was found that $3000 was available for distribution; two persons received the 10% maximum. The yearly output was doubled with slight increase in force; the unit cost of product was reduced 9% and the average gain to employees (over old day wages) was 19%. The plan is to be continued.

Wireless vs. Submarine Cables—Commenting upon the effect of the wireless telegraph upon the extension of the transoceanic cable system, the Deutschen Telegraphen Gesellschaft, which operates Atlantic cables between Germany and the United States, says in its recent annual report:

> The development of wireless telegraphy has taken such a form that its chief usefulness still consists in transmissions between ships and coasts or between the vessels themselves. It has also proved a very substantial feeder for telegraph and cable lines.
>
> The world's network of cables was extended during 1913 by 6875 miles. The Government cables increased 23% and private cables 11%. The German Cable Co., which is subsidized to a certain extent by the Imperial Government, earned net profits of $870,000 in 1913, as compared with $632,000 in 1912, and has declared a 7½% dividend.

Inauguration of State Aid Road Work in Illinois—On Apr. 15, Governor Dunne of Illinois turned the first shovelful of earth on the improvement of the Aurora-Elgin highway, reported to be the first state-aid road in Illinois. The Illinois road and bridge law was passed in 1913. There are a state highway commission of three members, a state highway engineer and an assistant state highway engineer. The state appropriated $400,000 in 1913-'14 and $700,000 for 1914-'15. State aid roads and bridges are constructed half at the expense of the county and half at the expense of the state, but the state agrees to perpetually maintain the structures thus built.

Elevating a Four-Track Roadbed and 30-Track Freight Yard on the main line of the Pennsylvania R.R. leading out of Pittsburgh, at Wilkinsburgh, Penn., is one of the most interesting and important engineering projects now in progress around Pittsburgh, Penn. The work involves the elevating of about two miles of four-track roadbed, and in addition a freight yard of about 30 tracks. This has to be done without interrupting traffic, which at this point is especially heavy, comprising several hundred trains per day. In addition all the block-signal and compressed-air interlocking systems have to be taken care of. Concrete retaining walls are being constructed and thousands of carloads of slag have been used in the fill.

First Use of the Panama Electric Towing Locomotives was made on Apr. 1, at Gatun Works. Locomotives 641, 642, 643 and 644 towed the launch "Balboa," clapet "No. 1," and a scow through the west flight from Gatun Lake to the Atlantic entrance channel. Clapet and scow were lashed together alongside, but the scow leading by half a length. The low freeboards gave as unfavorable inclination to the towing lines as probably ever will be secured in operation. Passage was completed in 1 hr. 17 min. which is only two minutes more than schedule fixed for operation. Extra lines were carried by laborers, but were not needed.

Two Small Isthmian Railways—The Panama Ry., 40 mi. in length, and the Tehuantepec Ry., 190 mi. long—carried in 1913 $130,500,000 worth of merchandise, brought to their termini by vessels from the United States, to be reloaded at the opposite termini and shipped to all parts of the United States and to foreign countries. This is double the amount thus transported in 1908, one year after the opening of the Tehuantepec line. Of the $84,000,000 worth of merchandise shipped from New York, $37,750,000 worth was consigned to San Francisco. San Francisco shipped $14,600,000 worth to New York. The value of American products carried by these routes was via the Panama Ry. $31,000,000 and via Tehuantepec Ry. $99,500,000. Two-thirds of this trade according to the latest compilations of the Department of Commerce moved westward.

For the Proposed Pymatuning Swamp Reclamation and storage reservoir scheme in Crawford County, Penn., the State Water Supply Commission has asked for an appropriation of $1,600,000. Already $10,000 has been expneded in surveys, investigations and reports, a review of which was published in "Engineering News," Apr. 17, 1913, p. 823. The legislature has recently appropriated $100,000 to begin construction. Pymatuning swamp covers over 10,000 acres near the summit of the divide between the Ohio River watershed and the Lake Erie watershed. The plan under consideration proposes the building of a dam which will convert a portion of the swamp and adjacent area into a storage reservoir. The dam would be approximately 3000 ft. long, with an average height of 27 ft., and provided with a concrete spillway. The object of the reservoir is to eliminate to a great degree the disastrous floods which now come down the Shenango and Beaver Rivers through Sharon, New Castle, Sharpsville and Beaver Falls, great steel centers, and at the same time supply the users of the water from these rivers with an increased amount during the dry summer seasons. The water-power development along this territory would be augmented by about 2000 hp. About 1500 acres of tillable land would be reclaimed. The carrying out of this project will necessitate the relocation of several miles of railroad, the construction of new highways and building of several new bridges. Farley Gannett, of Harrisburg, Penn., is the Chief Engineer of the Water Supply Commission, and has charge of the preliminary work.

Floods on the Lower Colorado River threatening the Imperial Valley in California were extensively reported during the past week. From present indications it would appear that the early reports were very much exaggerated and that the danger to the Valley is quite remote.

The reports gained currency from a "memorandum to the press" issued by the U. S. Department of the Interior under date of Apr. 22. This stated that "a break is reported in the rock-protected levees of the river on Mexican soil, through which the waters of the river are rushing and endangering the lives and property of the people of the valley. Hundreds of millions of dollars of improvements may be at the mercy of the flood . . . Gen. Wm. L. Marshall, Consulting Engineer to the Secretary of the Interior, has been assigned to duty and will depart today to take charge of the protection work. . . . At the same time the flood is threatening the safety of levees erected by the Reclamation Service in American territory for the protection of the Yuma Reclamation Project."

Later information from F. L. Sellew, Project Manager of the Yuma Reclamation Project, is to the effect that the earlier reports were exaggerated. He states that there is not any excessive flood in the Colorado and that on Apr. 23 the stage at Yuma was only 4 ft. above low water, with a discharge of 28,000 sec.ft., as compared with a low-water discharge of 3000 sec.-ft. and a maximum flood flow of 150,000 sec.ft. The bank on the Mexican side, 12 miles below Yuma, has been eroded and 1200 ft. of levee washed out, but at Yuma no serious menace to the bank seems probable. The work in progress near Yuma is merely to prevent erosion of the bank and consequent levee destruction.

Port Improvements at Savannah, Ga., now in progress or projected include deepening the river channel by the federal

government, a railway and steamship terminal under construction by the Central Railroad of Georgia and a municipal wharf. The federal government is providing a channel from the deep sea to the docks on the Savannah River, which will have a depth of 27 ft. at mean low water. The present controlling depth is 21½ ft. on one shoal at the mouth of the river. After the removal of this shoal, which is now in progress, the controlling depth will be 26 ft. According to the 1913 report of E. R. Conant, Chief Engineer of the City of Savannah, that city has an unbroken wharf frontage of four miles, of which 3.2 miles is within the city limits. On the other side of the river there are 0.8 mile of wharf frontage. Other wharves bring the total wharf frontage of the port up to 7.8 miles, but not all of this is developed. Of the developed frontage, the railroads own three miles, individuals own 1.6 miles and the city owns 1475 ft. The city also owns 3750 ft. of undeveloped frontage, of which 400 ft. is up the river above the city and the remainder on Fig Island. Until the city bought a wharf in 1913 it did not own enough wharfage to be of any practical use. A small length of city wharf will be built this season, under Mr. Conant's direction, probably making use of creosoted piles. Mr. Conant thinks the city should build still more wharves, but at present the demands of local traffic are not large and through traffic is handled by the railroads. The city has agreed to give land for a turning basin to the federal government, with the understanding that all the dredged material will be placed on city land. This will add a half mile to the city's dock frontage, all adjacent to deep water, so the city will need only to build bulkheads to get a desirable wharf property at low cost.

A Sanitary Survey of the Spokane River was begun late in 1912 and continued in 1913 by the engineering division and the city chemist of Spokane, Wash. An outline of the survey, with maps, tables and diagrams, makes up the larger part of the annual report for 1913 of Morton Macartney, City Engineer of Spokane. The report on the survey was written by A. D. Butler, Principal Assistant City Engineer, who was in direct charge of the work, and who acknowledges the coöperation of Fred E. Pegg, City Chemist, and J. P. Mader, Assistant to Mr. Pegg. Besides analyzing samples taken at five points, located from five miles above the city to the junction of the Spokane with the Columbia River, the survey included a number of dry-weather flow sewer gagings. Both bacterial and chemical analyses were made.

The Spokane River has a fall of about 1050, "pretty well distributed along the 140 miles of its length." In general, the stream is a swift one. A few dams aid in aëration, and pools formed by the dams aid in sedimentation. There is a population of about 60,000 in the drainage area above Spokane, mostly rural or in small villages. After reviewing the dilution limits of 3.3 to 6 cu.ft. of stream flow per 1000 population adopted or suggested in the East the report by Mr. Butler concludes as follows:

> Therefore, if the State Board of Health of Ohio considered the condition of the Scioto River permissible or the Ohio River not excessively polluted; and if the State Board of Health of Massachusetts considered that the Merrimack River was not too badly polluted then it would appear, judging from their standards, that the Spokane River is not liable to reach the danger point for some time in the future, especially when we observe that where the eastern rivers cited all flow through a thickly populated district (many villages and towns bordering on them), the Spokane River flows through a sparsely populated district, scarcely capable, due to the topography of its banks, of supporting a very great population at any time in the future. Also that where the eastern rivers mentioned have a low velocity and are inclined to be sluggish and not affording ample facilities for natural agencies to help purify the water by the mixing of oxygen with same, the Spokane River is ideally constituted in this respect, with alternate settling basins and aërating waterfalls and rapids. Again, where the physical character of the eastern rivers would encourage swimming and bathing in the summer time, thus increasing the liability of infection, the Spokane River is so swift and rocky and the water so cold even during the warmest weather, that it almost prohibits any liability of infection from this source. The chief source of infection is probably from fishermen wading in the stream or drinking from its waters.
>
> Again, the Chicago canal, after careful deliberation by one of our leading sanitarians, was designed on the basis of less than one-third of the dilution which the sewage from this city receives during the period of extreme low water, which lasts only a few days during each year. The Spokane River even furnishes twice as much dilution as the most conservative of our sanitarians would recommend. Hence it would appear from the standpoint of dilution, considered on the basis of population alone, without taking into account the actual strength of the sewage, but assuming that the sewage delivered from the Spokane sewers is of average strength, that the river water should be safely within the limits of good sanitary practice.
>
> It has further been shown by the analysis of the sewage from this city, that its general character is somewhat less concentrated than that of eastern cities, and hence should not require as much dilution. Also as previously stated, it will probably be shown on a more careful detormination of the amount of sanitary sewage actually entering the river, that the figure used in this report is considerably high. This again will make the condition of the river more favorable even than this report would indicate.

PERSONALS

Mr. C. W. Nelson, recently Assistant to the President of the St. Louis Southwestern Ry., has been elected Vice-President.

Mr. J. A. Rutledge has been appointed Roadmaster of the Detroit, Toledo & Ironton Ry., at Napoleon, Ohio, succeeding Mr. P. O'Brien, resigned.

Mr. Henry J. Conrath, formerly connected with the Henry Shenk Co., builders, of Erie, Penn., is now with the Liebel-Binney Construction Co., Erie.

Mr. A. W. Tuttle, formerly connected with the Henry Shenk Co., builders, of Erie, Penn., is now with the Liebel-Binney Construction Co., Erie.

Mr. Charles B. Breed, M. Am. Soc. C. E., Associate Professor of civil engineering at the Massachusetts Institute of Technology, has been promoted to the grade of Professor.

Mr. Alfred Ludwig, Chief Inspector of the Bureau of Buildings, Borough of Manhattan, New York City, is Acting Superintendent, succeeding Mr. Rudolph P. Miller, M. Am. Soc. C. E., resigned, as noted in our issue of Apr. 16, 1914.

Mr. R. W. Williams, formerly Assistant Engineer of the Southern Ry., at Birmingham, Ala., has been appointed Engineer of Construction in charge of double-tracking the Alabama Great Southern R.R., with headquarters at Birmingham.

Mr. George A. Gaston has been elected President of the Northwestern Pennsylvania Ry., succeeding Mr. Henry W. Thornton, former General Superintendent of the Long Island R.R., now General Manager of the Great Eastern Ry., in England.

Mr. Orrin L. Brodie, M. Am. Soc. C. E., former Assistant Designing Engineer, Board of Water Supply, City of New York, is now Associate Efficiency Engineer, Efficiency and Budget Advisory Staff, Board of Estimate and Apportionment, New York City.

Mr. John J. Treacy has been appointed a member of the Board of Public Utility Commissioners of New Jersey, succeeding Mr. Winthrop M. Daniels, recently appointed a member of the Interstate Commerce Commission. Mr. Tracy is a lawyer of Jersey City, N. J.

Mr. Charles P. Rumpf has resigned as Engineer for John D. Walsh, Inc., Contractor, Brooklyn, N. Y., to join Mr. Ralph F. Relly in forming the Northern Engineering & Contracting Co., with headquarters at Saranac Lake, N. Y. Mr. Relly is President and General Manager, and Mr. Rumpf is Secretary-Treasurer.

Mr. C. A. Gill, General Master Mechanic of the Baltimore & Ohio R.R., has been appointed Assistant District Superintendent of Motive Power, at Baltimore, Md., succeeding Mr. J. W. G. Brewer, resigned. Mr. Gill was formerly Master Mechanic of the Cincinnati, Hamilton & Dayton Ry., at Ivorydale, Ohio.

Mr. Walter Raschals, for the past 12 years associated with Mr. Julian Kennedy, M. Am. Soc. M. E., Consulting Mechanical Engineer, Pittsburgh, Penn., has opened an office for private practice in the Stanlaugh Bldg., Youngstown, Ohio, specializing in steel-mill and blast-furnace construction. Mr. Raschals was formerly Chief Engineer of the National Steel Co., of Pittsburgh.

Mr. J. B. Berry, M. Am. Soc. C. E., whose resignation as Assistant to the President of the Chicago, Rock Island & Pacific Ry. was noted in our issue of Apr. 9, 1914, has become associated with the firm of Howard & Roberts, Consulting Engineers, of Chicago, Ill. The firm name will now be Berry, Howard & Roberts, with offices at 1640 Transportation Bldg., Chicago, Ill.

Mr. Spencer J. Stewart, Assoc. M. Am. Soc. C. E., and the other five men who were convicted of conspiracy to defraud the State of New York in connection with the construction of public roads on Long Island, as noted in our issue of last week, have been sentenced to eight months in the county jail. They have been released on $5000 bail each, pending an appeal granted on a certificate of reasonable doubt.

Mr. I. F. White, formerly Division Engineer of the Cincinnati, Hamilton & Dayton Ry., at Dayton, Ohio, has been apointed Engineer of Maintenance-of-way of the Chicago Great Western Ry., with headquarters at Chicago, Ill., suc-

...ing Mr. C. G. Delo, promoted. Mr. White began his railroad experience with a survey party on the New York, Lake Erie & Western R.R. in 1878. He was with various railroads in Pennsylvania and Ohio until 1891, when he was appointed Assistant Engineer of the Cincinnati, Hamilton & Dayton Ry.

Mr. Alexander Thomson, Jr., M. Am. Soc. C. E., Division Engineer of the Board of Water Supply, City of New York, has resigned to enter a partnership with Mr. Floyd Wooster, of Walden, N. Y., under the firm name of the Thomson-Wooster Co., Contractors, with headquarters at Walden. Mr. Thomson graduated in civil engineering at Cornell University in 1899, and for a year was in railway work in Pennsylvania and New Jersey. For four years he was Assistant Engineer of the New York City Rapid Transit Commission. Since 1905 he has been with the Board of Water Supply.

Mr. J. R. Holman, Chief Engineer of the Northern lines of the Oregon-Washington R.R. & Navigation Co., at Seattle, Wash., has been appointed Chief Engineer of the Southern lines, with headquarters at Portland, Ore., succeeding Mr. G. W. Boschke, resigned, as noted in our issue of last week. Mr. Holman is a graduate of the Agricultural and Mechanical College of Texas and began engineering work on the construction of a railroad in Spanish Honduras, Central America. He has been with the Union Pacific R.R. system in Oregon and Washington since 1905.

Mr. Theodore A. Leisen, M. Am. Soc. C. E., Chief Engineer and Superintendent of the Louisville Water Co., Louisville, Ky., has been appointed Chief Engineer of the Detroit, Mich., Board of Water Commissioners, succeeding Mr. G. H. Fenkell, M. Am. Soc. C. E., who resigned last summer to become Commissioner of Public Works of Detroit. Mr. Leisen was born in Philadelphia, Penn., in 1876. For a number of years following his school work he was in railway work in this country and in South America. For six years he was Chief Engineer and Superintendent of the waterworks of Wilmington, Del. Since 1908 he has been Chief Engineer and Superintendent of the Louisville Water Co. At Wilmington he designed and supervised construction of the pumping station, reservoir and filtration plant, and at Louisville the new 40,000,000-gal. extension filter plant now nearing completion. Mr. Leisen's appointment is effective June 1.

Governor Fielder, of New Jersey, has appointed a State Harbor Commission, under a law recently enacted, as follows: Messrs. J. Spencer Smith, of Tenafly, President; Richard C. Jenkinson, of Newark; William L. Saunders, M. Am. Soc. C. E., of North Plainfield; W. Parker Runyon, of Perth Amboy, and Charles S. Boyer, of Camden. Mr. Edward A. Ransom, Jr., is Secretary. Mr. B. F. Cresson, Jr., M. Am. Soc. C. E., former Deputy Commissioner of Docks and Ferries, New York City, is Engineer, and Brig.-Gen. William T. Rossell, former Chief of Engineers, U. S. A., is Consulting Engineer. Under the law creating the Harbor Commission it is to investigate and report annually the condition of the waterfront or harbor facilities. All plans for waterfront improvement by private parties must be passed upon by the Harbor Commission. The Harbor Commission is to propose and plan developments at the request of any town or municipality. The Commission has been in existence for some time under a temporary appointment. The present law makes it permanent.

OBITUARY

David Robinson, a pioneer electric-railway builder, of Toledo, Ohio, died Apr. 15, aged 85 years.

Albert Stearns, M. Am. Soc. M. E., Superintendent of Church & Dwight Co., Brooklyn, N. Y., died recently at his home in Brooklyn. He was a charter member of the American Society of Mechanical Engineers.

Samuel Davis Kendall, a retired civil engineer, of San Francisco, Calif., died Apr. 14, aged 83 years. Before going to California in 1887 he was connected with the location surveys and construction of the Massachusetts Central R.R. He surveyed some of the earliest electric-railway lines in California.

George F. Baer, President of the Philadelphia & Reading Ry., died Apr. 26, at his home in Philadelphia, Penn., aged 72 years. He was born in Somerset County, Penn., in 1842. At the age of 13 years he started to learn the printers' trade; afterward he studied law and was admitted to the Pennsylvania bar in 1864. For several years he was in private practice in Reading, Penn. In 1870 he was appointed Counsel of the Philadelphia & Reading Ry. He took an active part in the reorganization of the company in 1901 and was elected President of the Reading Co., the Philadelphia & Reading Ry. and the Central R.R. of New Jersey. He was chiefly noted as the leader of the coal operators in the bitter labor war of 1902.

Fred Thompson, Civil Engineer, United States Navy, died Apr. 22, at San Diego, Calif., where he had been stationed since June, 1913. Mr. Thompson was a native of Washington, D. C. He graduated in civil engineering at the Massachusetts Institute of Technology in 1887, and his first engineering experience was with the Southern Ry. In 1898 he was appointed Assistant Civil Engineer, U. S. N., and at the time of his death had the rank of Lieutenant-Commander. He served at the Norfolk Navy Yard, the Boston Navy Yard, the naval station at San Juan, Porto Rico, the naval coaling station at San Francisco, and the naval station on the Island of Guam.

James J. Harding, M. Am. Soc. C. E., formerly Engineer of Masonry Construction of the Chicago, Milwaukee & St. Paul Ry., and a member of the bridge and building and engineering departments of that road from 1895 to 1910, died at Seattle, Wash., Feb. 28. He was born in Dickinson County, Kan., Mar. 8, 1872, and was the son of Gilman Carey and Frances Smith Harding. When eight years old his parents moved to Leavenworth, Kan. After passing through the high school there, and spending a year with the Missouri Valley Bridge & Iron Co., he entered the Kansas State University at Lawrence, in 1891, graduating in the course of electrical engineering in June, 1895, with the degree of Bachelor of Science. In 1895 he went to Chicago and after a short time in the employ of the American Bridge Co., entered the bridge and building department of the C., M. & St. P. Ry., of which Onward Bates, Past-President, Am. Soc. C. E., was then Engineer and Superintendent. Mr. Harding occupied positions of increasing responsibility in the drafting room of that department until in 1901 he was Assistant Engineer in charge and responsible for all plans required by the large field of activity of the department. In 1905, when the construction of the Puget Sound extension was commenced, Mr. Harding was made Engineer of Masonry Construction and had the supervision of the field forces engaged in building the many masonry structures, not only on the old lines but also on the new line, including the bridge over the Missouri River at Mobridge. In the fall of 1907, in order that he might be in closer touch with the work on the new lines, which demanded constant attention, Mr. Harding was relieved of duties on the old lines and his headquarters were transferred to Miles City, Mont. It was while located there that when on a motor trip, Mr. Harding met with an accident, due to the derailment of his car by an obstruction placed on the rail. In a few weeks, however, he was again at work. In 1909 the development of the new line in Washington State called for the organizing of a bridge and building department, and Mr. Harding was transferred to Seattle for that purpose. There he continued his work as long as his health permitted, but in 1910 his health failed and incapacitated him from arduous work. It was hoped that a period of rest would enable him to return to work again, but this hope was not fulfilled. He was a member of the Western Society of Engineers. The interment took place at Leavenworth, Kan., on Mar. 8, and was attended by many of his old schoolmates, six of whom were pallbearers. Mr. Harding is survived by his widow and an adopted daughter, Virginia Walker Harding, who make their home in Seattle.

ENGINEERING SOCIETIES

COMING MEETINGS

NATIONAL FIRE PROTECTION ASSOCIATION.
May 5-7. Annual meeting in Chicago, Ill. Secy., Franklin H. Wentworth, 87 Milk St., Boston, Mass.

AIR BRAKE ASSOCIATION.
May 5-8. Convention at Detroit, Mich. Secy., F. M. Nelis, 53 State St., Boston, Mass.

AMERICAN WATER-WORKS ASSOCIATION.
May 11-15. 34th Convention at Philadelphia, Penn. Secy., J. M. Diven, 47 State St., Troy, N. Y.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.
May 18-21. 6th convention in Chicago, Ill. Secy., C. G. Hall, C. & E. I. R.R., 922 McCormick Bldg., Chicago, Ill.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.
May 20-23. Annual meeting at Galveston, Tex. Secy., H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

SIXTH NATIONAL CONFERENCE ON CITY PLANNING.
May 25-27. Toronto, Ont. Secy., Flavel Shurtleff, 19 Congress St., Boston, Mass.

MASTER BOILER MAKERS' ASSOCIATION.
May 25-28. Convention at Philadelphia, Penn. Secy., H. D Vought, 95 Liberty St., New York City.